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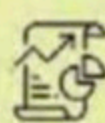
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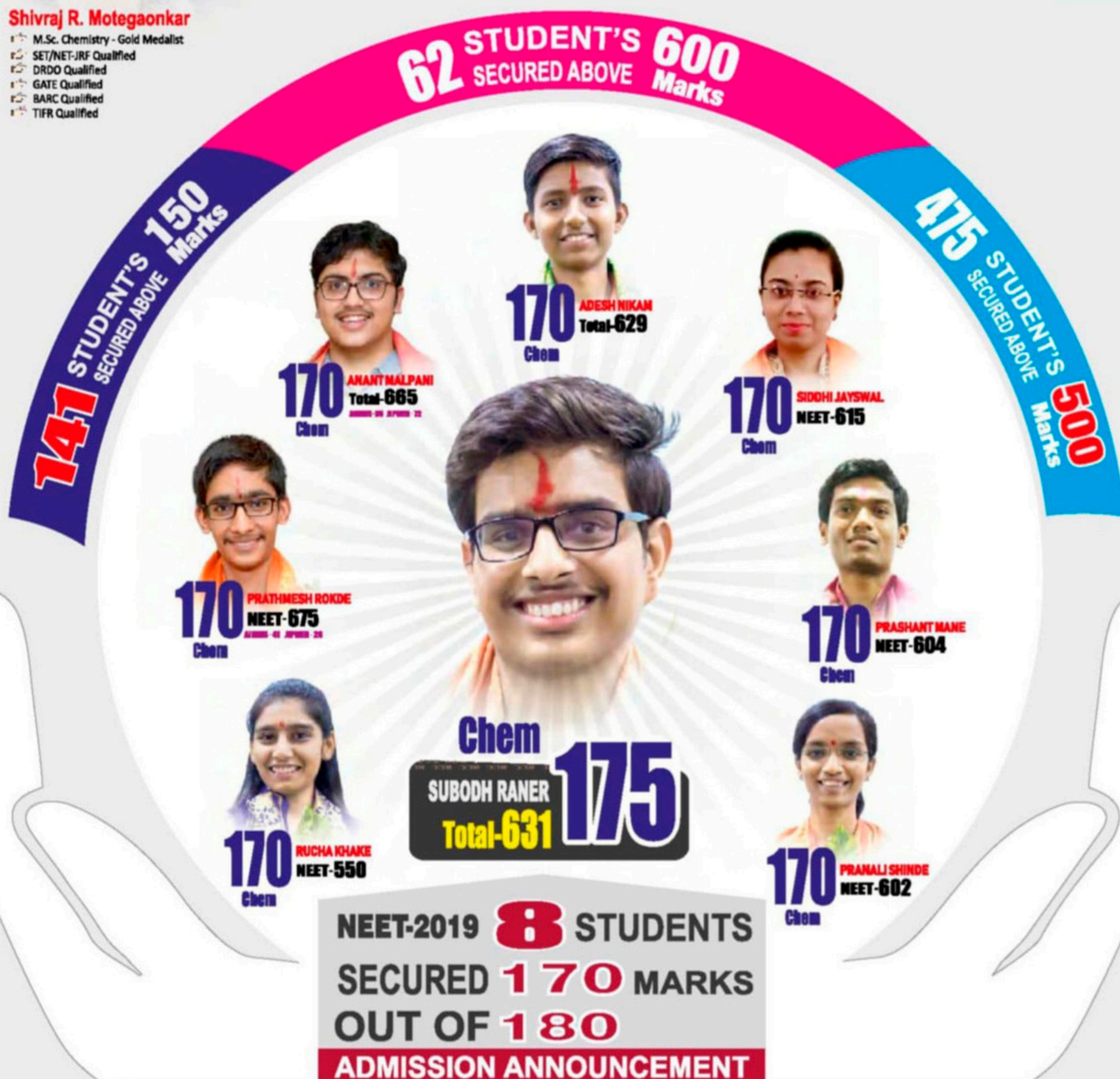
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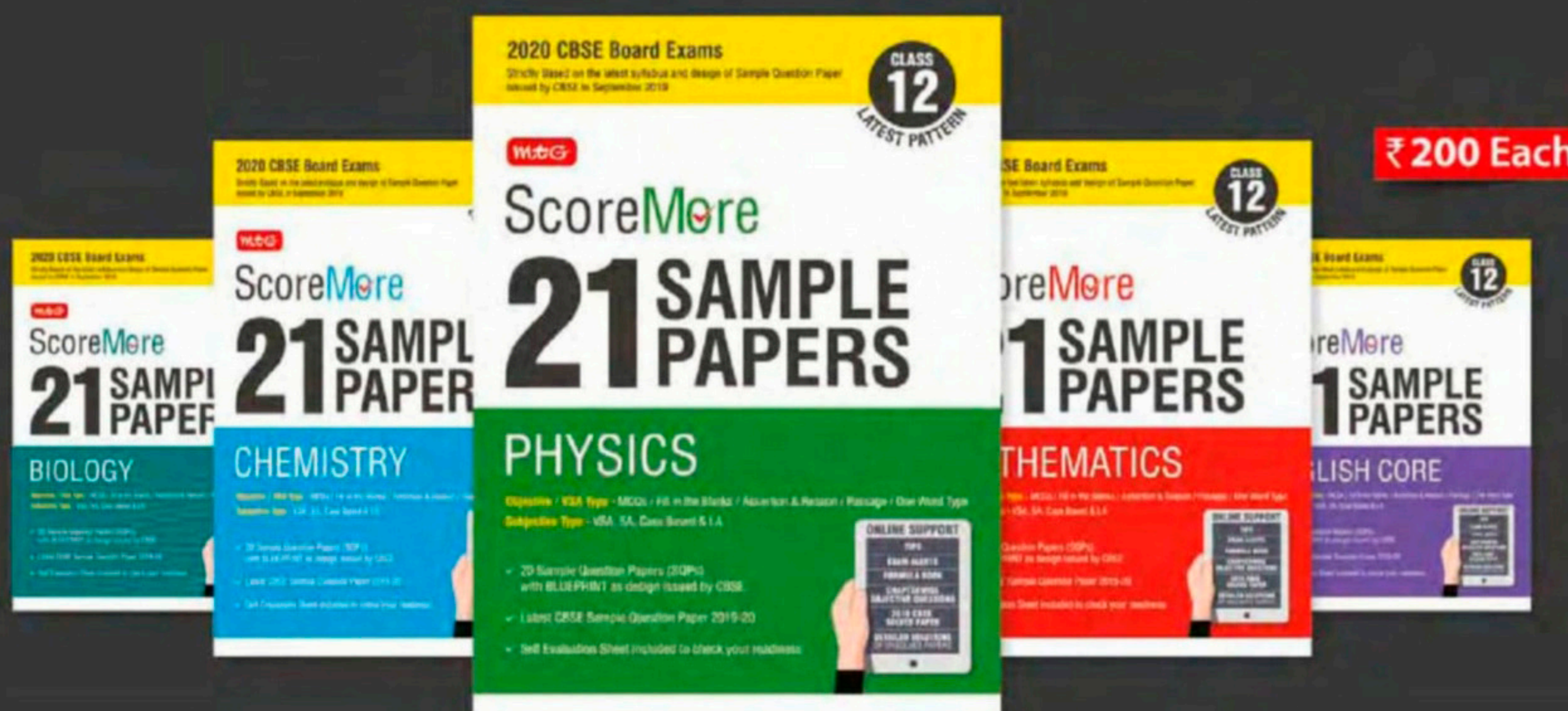
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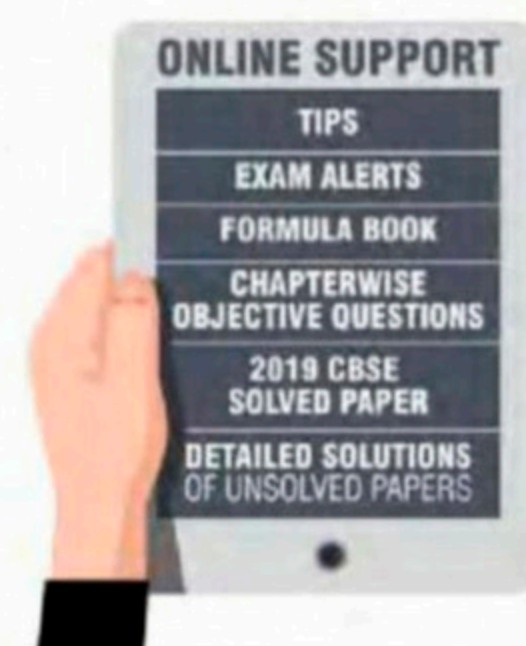


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## HIGHLIGHTS

- ✓ **Objective / VSA Type** - MCQs / Fill in the Blanks / Assertion & Reason / Passage / One Word Type
- ✓ **Subjective Type** - VSA, SA, Case Based & LA
- ✓ 20 Sample Question Papers (SQPs) with BLUEPRINT as design issued by CBSE
- ✓ Latest CBSE Sample Question Paper 2019-20
- ✓ Self Evaluation Sheet included to check your readiness



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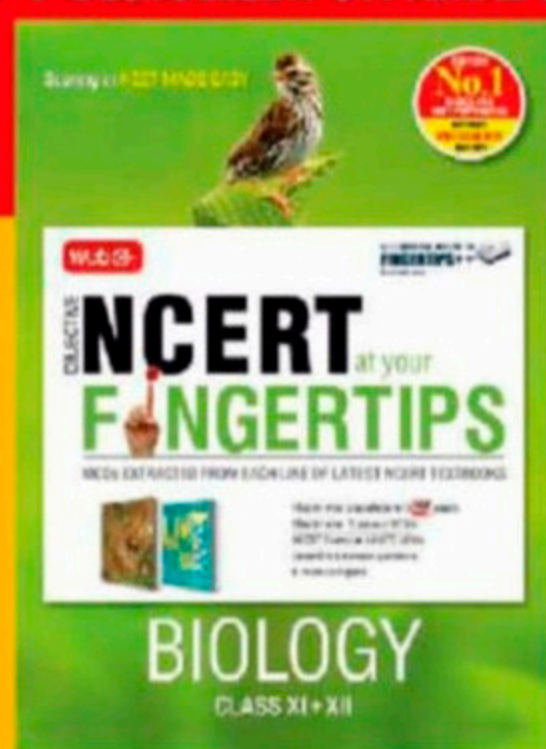
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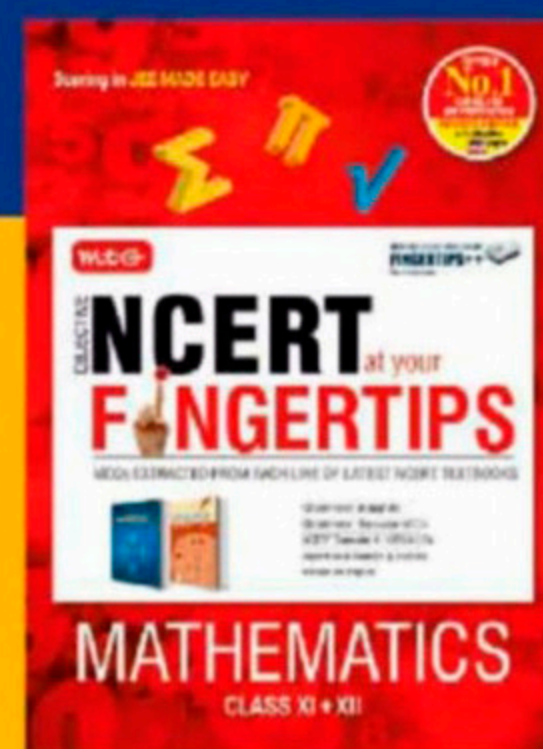
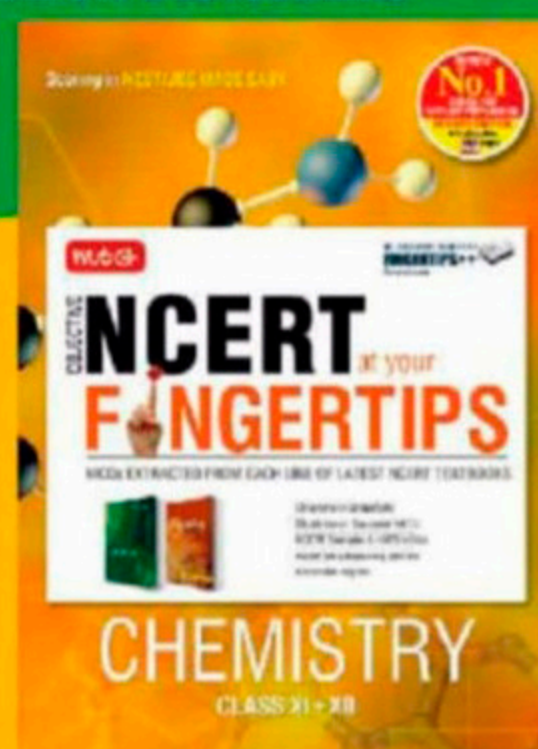
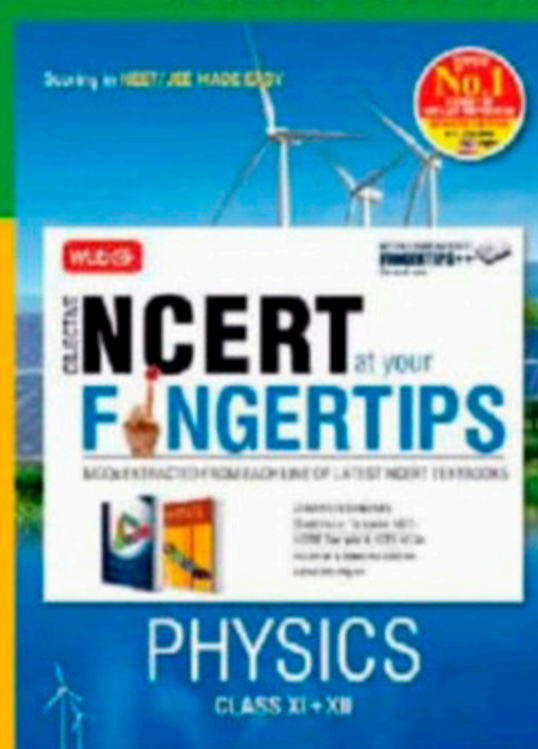
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# CHEMISTRY Musing

## PROBLEM SET 79

Chemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET with additional study material.

In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.

The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

### JEE MAIN/NEET

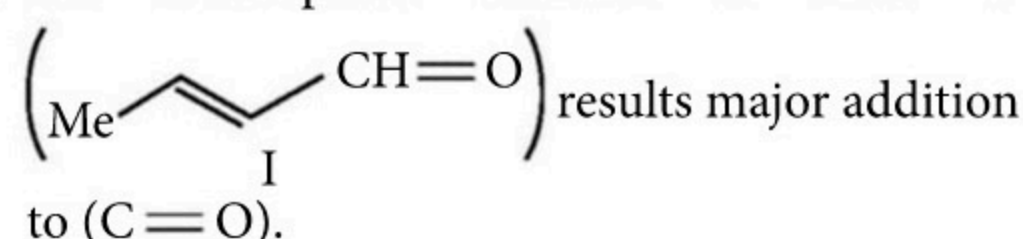
- n*-Butane is produced by the monobromination of ethane followed by the Wurtz reaction. What would be the volume of ethane at NTP required to produce 55 g of *n*-butane, if the bromination takes place with 90 percent yield and the Wurtz reaction with 85 percent yield?  
(a) 55.552 L (b) 66.662 L  
(c) 42.322 L (d) 48.202 L
- For the following sequence of reactions,  
(A) +  $K_2CO_3$  + air  $\xrightarrow{\text{Heat}}$  (B)  
(B) +  $Cl_2 \longrightarrow$  (C)  
which of the following is correct?  
(a) (A) is black,  $MnO_2$ ; (B) is blue,  $K_2MnO_4$  and (C) is pink,  $KMnO_4$   
(b) (A) is green,  $Cr_2O_3$ ; (B) is yellow,  $K_2CrO_4$  and (C) is pink,  $K_2Cr_2O_7$   
(c) (A) is black,  $MnO_2$ ; (B) is green,  $K_2MnO_4$  and (C) is pink,  $KMnO_4$   
(d) (A) is black,  $Bi_2O_3$ ; (B) is colourless,  $KBiO_2$  and (C) is pink,  $KBiO_3$
- One mole of  $N_2$  and 3 moles of  $PCl_5$  are placed in a 100 litre vessel heated to  $227^\circ C$ . The equilibrium pressure is 2.05 atm. Assuming ideal gas behaviour, the degree of dissociation of  $PCl_5$  and  $K_p$  of the reaction respectively are  
(a) 0.3313, 0.20 (b) 0.4152, 0.30  
(c) 0.2152, 0.23 (d) 0.4925, 0.33
- A metal complex having composition  $Cr(NH_3)_4Cl_2Br$  has been isolated in two forms (A) and (B). The form (A) reacts with  $AgNO_3$  to give a white precipitate readily soluble in dilute aqueous ammonia whereas (B) with  $AgNO_3$  gives a pale yellow precipitate soluble in concentrated ammonia. The magnetic moments (spin-only value) of A and B respectively are  
(a) 3.87 B.M. and 5.92 B.M.  
(b) 1.42 B.M. and 3.87 B.M.

(c) 3.87 B.M. and 3.87 B.M.

(d) 5.92 B.M. and 3.87 B.M.

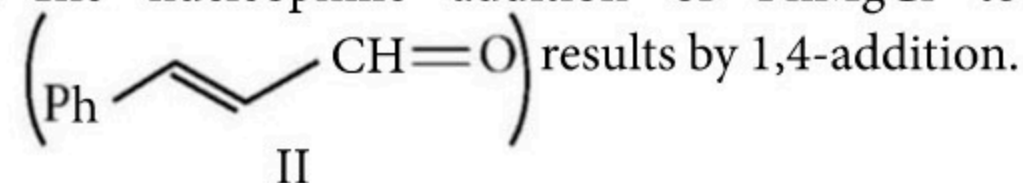
- Which of the following statements is incorrect?

(a) The nucleophilic addition of HCN to

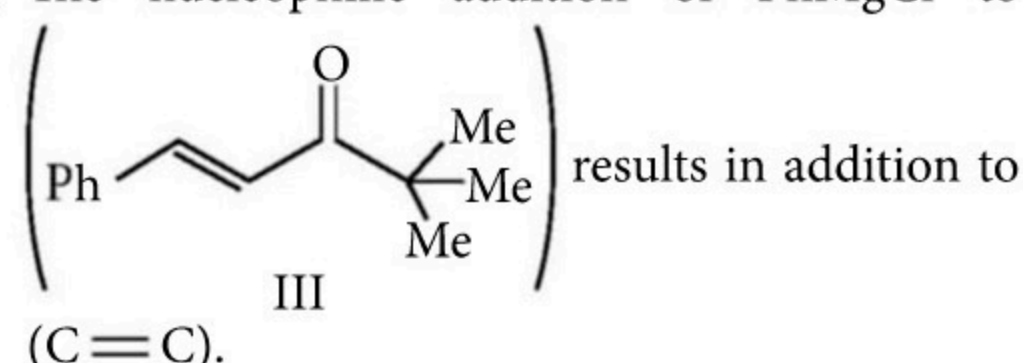


(b) The nucleophilic addition of HCN to (I) results major addition to (C=C).

(c) The nucleophilic addition of  $PhMgCl$  to



(d) The nucleophilic addition of  $PhMgCl$  to



### JEE ADVANCED

- Compound A ( $C_8H_8O$ ) on treatment with  $NH_2OH \cdot HCl$  gives (B) and (C). (B) and (C) rearrange to give (D) and (E), respectively, on treatment with acid. (B), (C), (D) and (E) are all isomers of molecular formula ( $C_8H_9NO$ ). When (D) is boiled with alcoholic KOH, an oil (F) ( $C_6H_7N$ ) separates out. (F) reacts rapidly with  $CH_3COCl$  to

#### Solution Senders of Chemistry Musing

##### Set - 78

- Akash Arora, Chandigarh
- Ritika Singh, West Bengal
- Atharva Rathore, New Delhi

#### Solution Senders of Unscrambled Words

- Archisha Agrawal, Rajasthan
- Rishabh Kumar, New Delhi



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## HIGHLIGHTS

- 10 very similar practice sets
- OMR sheet provided at the end of each set
- Detailed solutions of each practice set
- NEET 2019 solved paper included



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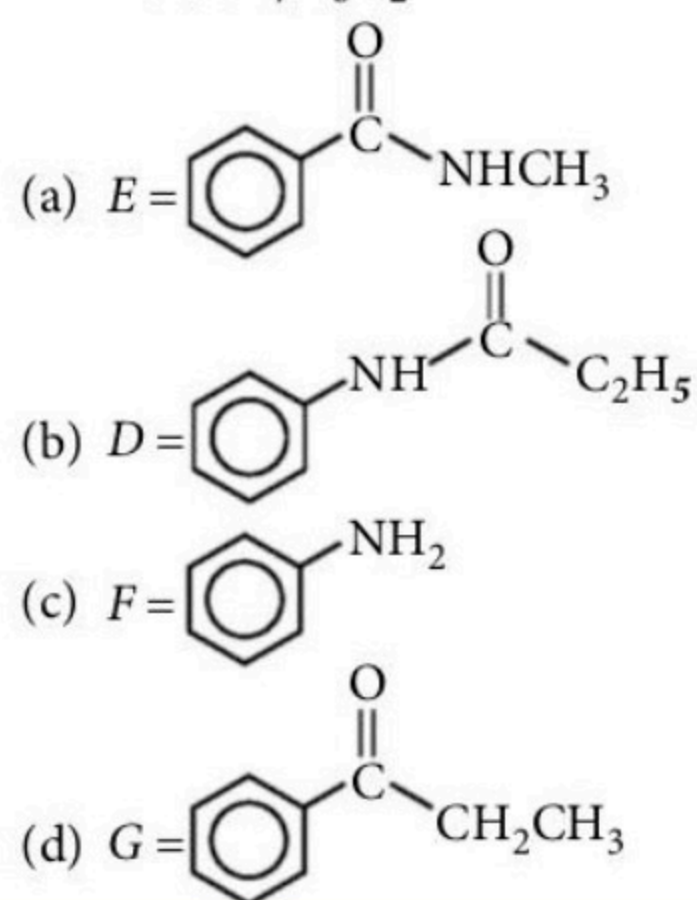
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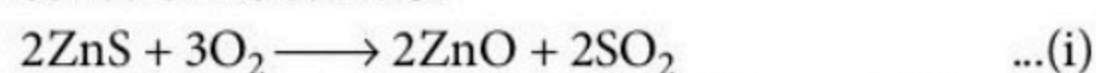


give back (D). On the other hand, (E) on boiling with alkali followed by acidification gives a white solid (G) ( $C_7H_6O_2$ ). Select the correct option(s).

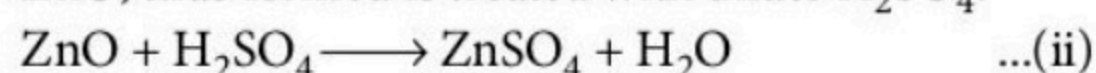


### COMPREHENSION

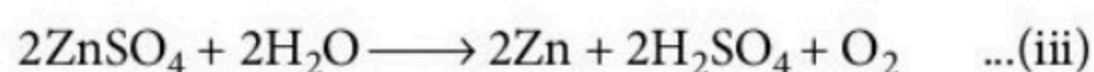
Chief ore of Zn is ZnS. The ore is concentrated by froth floatation process and then heated in air to convert ZnS to ZnO.



ZnO, thus formed is treated with dilute  $\text{H}_2\text{SO}_4$ .



On electrolysis of  $\text{ZnSO}_4(\text{aq})$ , Zn metal is produced.



7. How many kilomoles of NaOH are required to dissolve all the ZnO produced in reaction (i) which contains 225 kg of ZnS ore?  
(a) 1.16 (b) 2.32 (c) 4.64 (d) 9.28
8. What volume of 98%  $\text{H}_2\text{SO}_4$  (by weight, density = 1.8 g/mL) is required in step (ii)?  
(a) 120 L (b) 123 L (c) 1.40 L (d) 150 L

### INTEGER VALUE

9. 5 mL of 8 N  $\text{HNO}_3$ , 4.8 mL of 5 N  $\text{HCl}$  and a certain volume of 17 M  $\text{H}_2\text{SO}_4$  are mixed together and made upto 2 litres. 30 mL of this acid mixture exactly neutralises 42.9 mL of  $\text{Na}_2\text{CO}_3$  solution containing 1 g of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  in 100 mL of water. What would be the amount of sulphate ions (in grams) present in the solution?
10. What would be the potential of an indicator electrode versus the standard hydrogen electrode, which originally contains 0.1 M  $\text{MnO}_4^-$  and 0.8 M  $\text{H}^+$  and which was treated with  $\text{Fe}^{2+}$  necessary to reduce 90% of  $\text{MnO}_4^-$  to  $\text{Mn}^{2+}$ ? ( $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$ )

## UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

### Column I

- WETPER
- SEDMPMAYRUOI
- GINSRITEN
- RDISVGIER
- IOCTDOSECN
- TDAMANAENA
- LEKPSIEHNAN
- CFEIREROECTSRL

### Column II

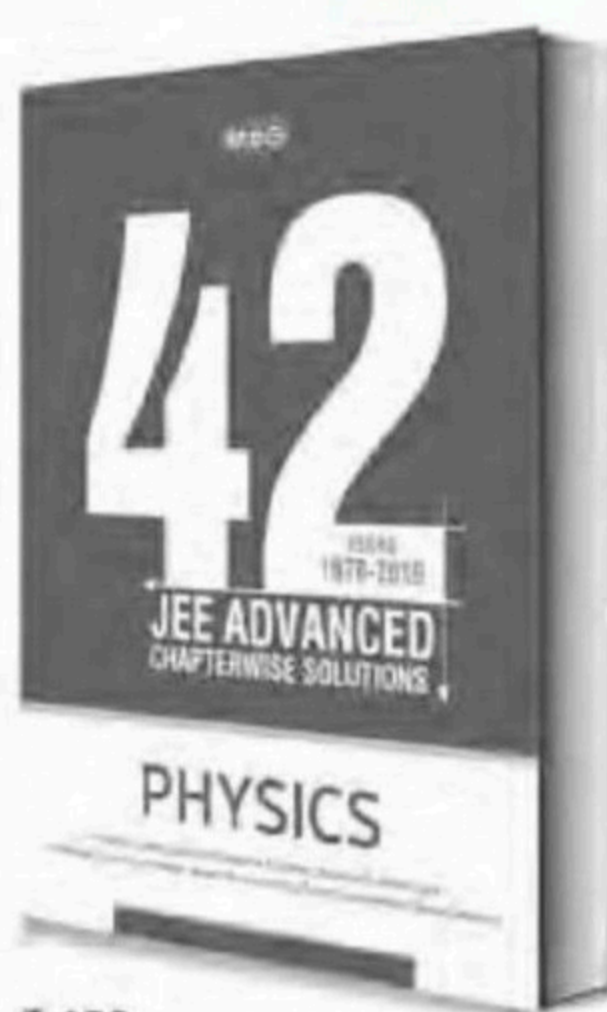
- Soft, ductile, malleable, silvery element used in the preparation of alloy.
- Pentapeptides, which occur naturally in the brain and are natural analgesic.
- Useful against viral infections, also used in treating Parkinson's disease.
- Compounds which show dielectric hysteresis, i.e., a reversible spontaneous polarizing due to non-cancellation of the elementary dipoles in a crystal.
- A process which involves the coagulation of powdered substances into a single mass by heating below the melting point of substances.
- Aqueous medicinal preparation obtained by boiling herbal or plant materials with water followed by filtration.
- It consists mainly of tin with varying small amount of copper, antimony and lead.
- It is used as a pigment, fungicide and mordant in dyeing.

Readers can send their responses at [editor@mtg.in](mailto:editor@mtg.in) or post us with complete address by 10<sup>th</sup> of every month. Names of solution senders will be published in next issue.

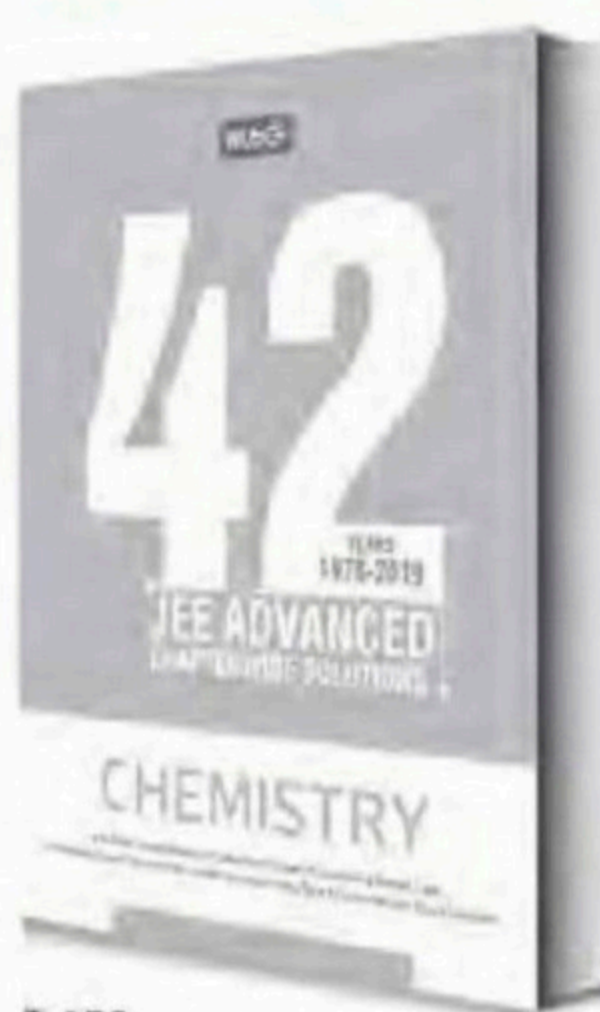




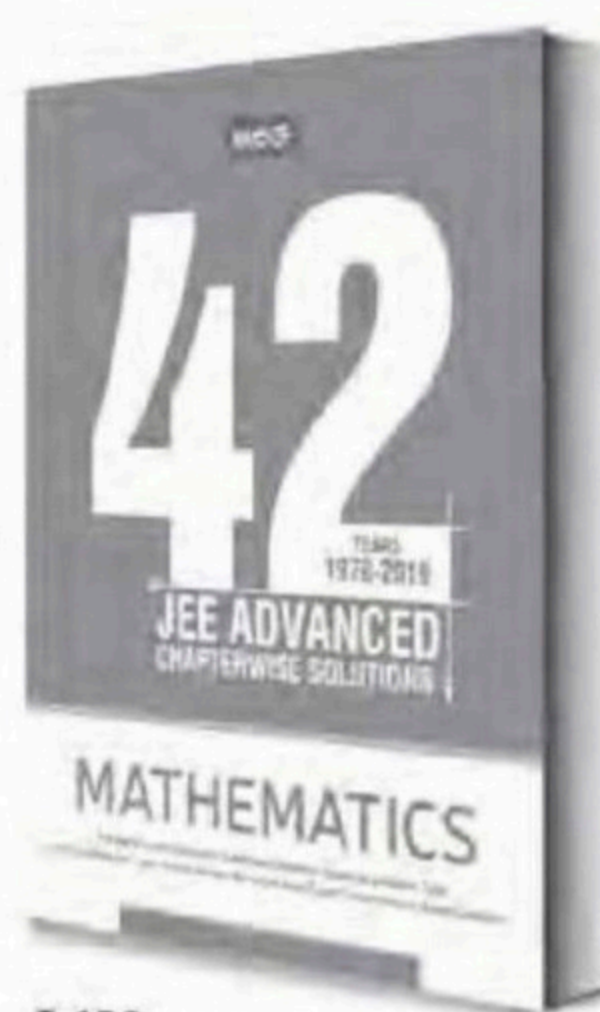
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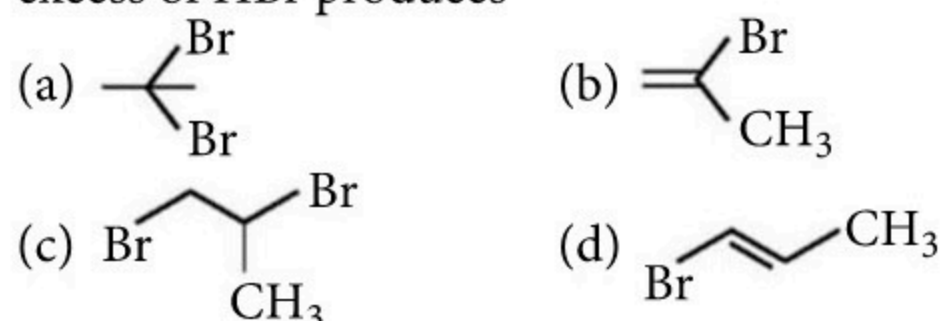
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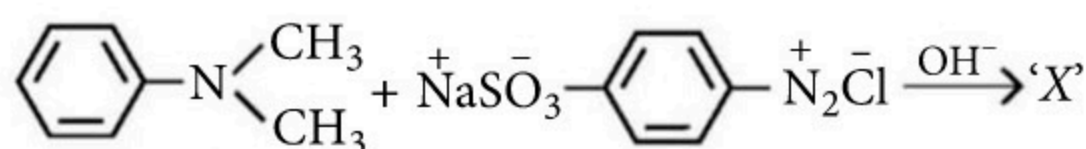
# JEE MAIN 2020

1. At 35 °C, the vapour pressure of CS<sub>2</sub> is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS<sub>2</sub> in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is
- heat must be absorbed in order to produce the solution at 35°C
  - a mixture of 100 mL CS<sub>2</sub> and 100 mL acetone has a volume < 200 mL
  - CS<sub>2</sub> and acetone are less attracted to each other than to themselves
  - Raoult's law is not obeyed by this system.

2. 1-Methyl ethylene oxide when treated with an excess of HBr produces



3. Consider the following reaction,



The product 'X' is used

- in protein estimation as an alternative to ninhydrin
  - in laboratory test for phenols
  - as food grade colourant
  - in acid-base titration as an indicator.
4. A solution of *m*-chloroaniline, *m*-chlorophenol and *m*-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of NaHCO<sub>3</sub> to give fraction A. The left over organic phase was extracted with dilute NaOH solution to give fraction B. The final organic layer was labelled as fraction C. Fractions A, B and C, contain respectively

- m*-chlorobenzoic acid, *m*-chloroaniline and *m*-chlorophenol
- m*-chlorobenzoic acid, *m*-chlorophenol and *m*-chloroaniline
- m*-chlorophenol, *m*-chlorobenzoic acid and *m*-chloroaniline
- m*-chloroaniline, *m*-chlorobenzoic acid and *m*-chlorophenol.

5. The purest form of commercial iron is
- wrought iron
  - pig iron
  - scrap iron and pig iron
  - cast iron.

6. Amongst the following statements that which was not proposed by Dalton, was
- all the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass
  - matter consists of indivisible atoms
  - when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same *T* and *P*
  - chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.

7. The atomic radius of Ag is closest to
- Au
  - Ni
  - Hg
  - Cu.

8. The IUPAC name of the complex [Pt(NH<sub>3</sub>)<sub>2</sub>Cl(NH<sub>2</sub>CH<sub>3</sub>)]Cl is
- diammine(methanamine)chloridoplatinum(II) chloride
  - diamminechlorido(methanamine)platinum(II) chloride
  - diamminechlorido(aminomethane)platinum (II) chloride
  - bisammine(methanamine)chloridoplatinum(II) chloride.



9. The theory that can completely/properly explain the nature of bonding in  $[\text{Ni}(\text{CO})_4]$  is  
 (a) molecular orbital theory  
 (b) crystal field theory  
 (c) Werner's theory (d) valence bond theory.

10. Match the following :

- |                   |                 |
|-------------------|-----------------|
| (A) Riboflavin    | I. Beriberi     |
| (B) Thiamine      | II. Scurvy      |
| (C) Pyridoxine    | III. Cheilosis  |
| (D) Ascorbic acid | IV. Convulsions |
- (a) (A)  $\rightarrow$  I, (B)  $\rightarrow$  IV, (C)  $\rightarrow$  III, (D)  $\rightarrow$  II  
 (b) (A)  $\rightarrow$  III, (B)  $\rightarrow$  I, (C)  $\rightarrow$  IV, (D)  $\rightarrow$  II  
 (c) (A)  $\rightarrow$  III, (B)  $\rightarrow$  IV, (C)  $\rightarrow$  I, (D)  $\rightarrow$  II  
 (d) (A)  $\rightarrow$  IV, (B)  $\rightarrow$  II, (C)  $\rightarrow$  I, (D)  $\rightarrow$  III

11. The dipole moments of  $\text{CCl}_4$ ,  $\text{CHCl}_3$  and  $\text{CH}_4$  are in the order

- (a)  $\text{CH}_4 = \text{CCl}_4 < \text{CHCl}_3$   
 (b)  $\text{CHCl}_3 < \text{CH}_4 = \text{CCl}_4$   
 (c)  $\text{CH}_4 < \text{CCl}_4 < \text{CHCl}_3$   
 (d)  $\text{CCl}_4 < \text{CH}_4 < \text{CHCl}_3$

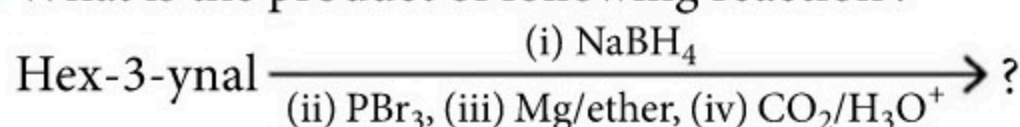
12. Given that the standard potentials ( $E^\circ$ ) of  $\text{Cu}^{2+}/\text{Cu}$  and  $\text{Cu}^+/\text{Cu}$  are 0.34 V and 0.522 V respectively, the  $E^\circ$  of  $\text{Cu}^{2+}/\text{Cu}^+$  is

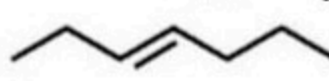
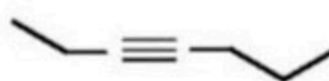
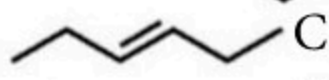

- (a) -0.182 V (b) +0.158 V  
 (c) -0.158 V (d) 0.182 V.

13. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine respectively, are

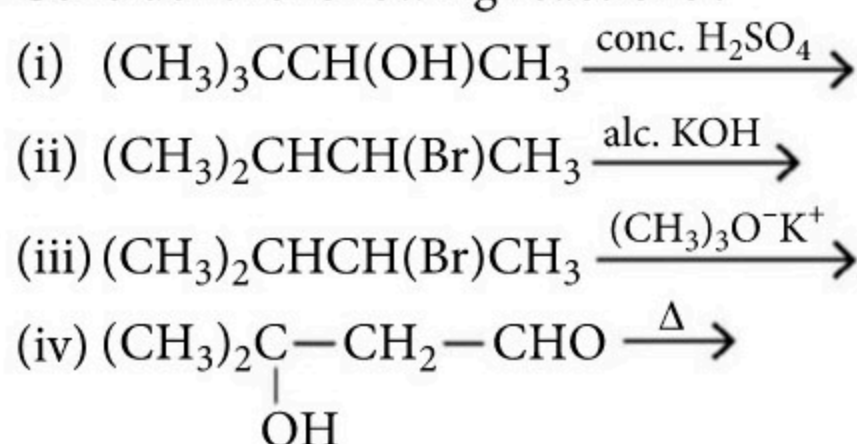
- (a) -333, -349, -325 and -296  
 (b) -349, -333, -325 and -296  
 (c) -296, -325, -333 and -349  
 (d) -333, -325, -349 and -296

14. What is the product of following reaction?



- (a)  COOH  
 (b)  COOH  
 (c)  COOH  
 (d)  COOH

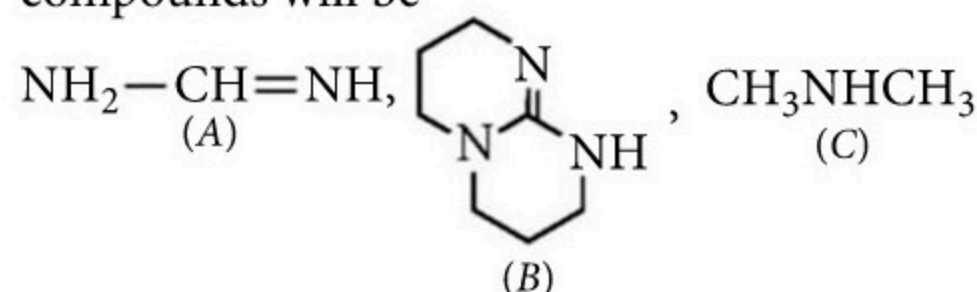
15. Consider the following reactions :



Which of these reaction(s) will not produce Saytzeff product?

- (a) (iii) only (b) (ii) and (iv)  
 (c) (i), (iii) and (iv) (d) (iv) only

16. The increasing order of  $\text{p}K_b$  for the following compounds will be



- (a) (B) < (C) < (A) (b) (C) < (A) < (B)  
 (c) (A) < (B) < (C) (d) (B) < (A) < (C)

17. The number of orbitals associated with quantum numbers  $n = 5$ ,  $m_s = +\frac{1}{2}$  is  
 (a) 25 (b) 11 (c) 15 (d) 50

## For the SCIENTIST in YOU

### Old newspapers can be used to grow carbon nanotubes

Newspapers provide a green, economical way to produce carbon nanotubes. Newspapers can be used as a low cost, eco-friendly material on which to grow single walled carbon nanotubes on a large scale.

Carbon nanotubes are tiny molecules with incredible physical properties that can be used in a huge range of things, such as conductive films for touchscreen displays, flexible electronics, fabrics that create energy and antennas for 5G networks.

The researchers' team discovered that the large surface area of newspapers provided an unlikely but ideal way to chemically grow carbon nanotubes. Researchers said,

"Newspapers have the benefit of being used in a roll-to-roll process in a stacked form making it an ideal candidate as a low-cost stackable 2D surface to grow carbon nanotubes." However, not all newspapers are equally good, only newspapers produced with sizing made from kaolin, which is China clay, resulted in carbon nanotube growth.

"Many substances including talc, calcium carbonate, and titanium dioxide can be used in sizing in papers which act as a filler to help with their levels of absorption and wear. However, it was observed that kaolin sizing, and not calcium carbonate sizing, showed how the growth catalyst, which in case of iron, is affected by the chemical nature of the substrate."

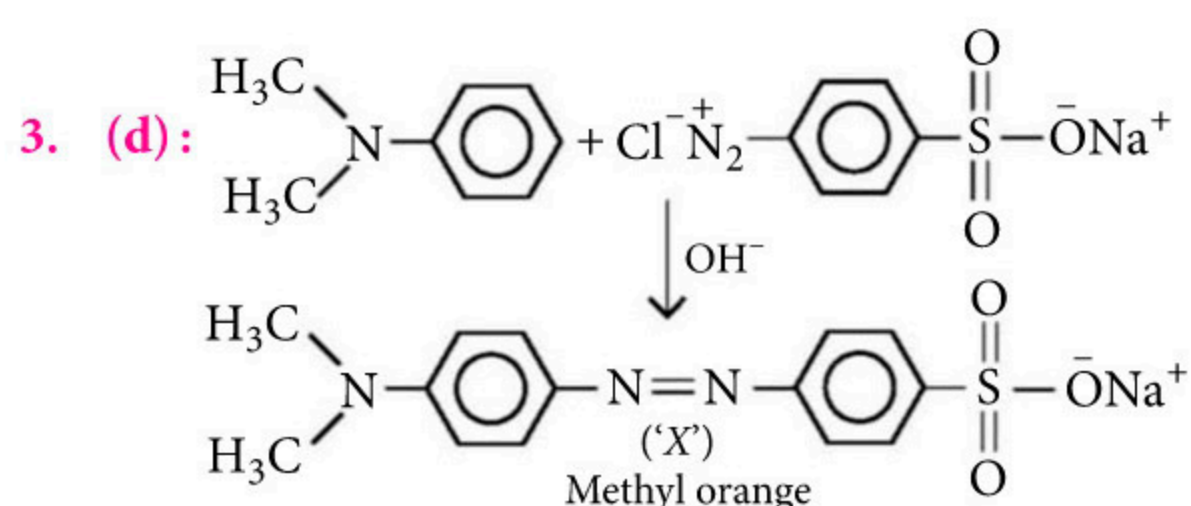
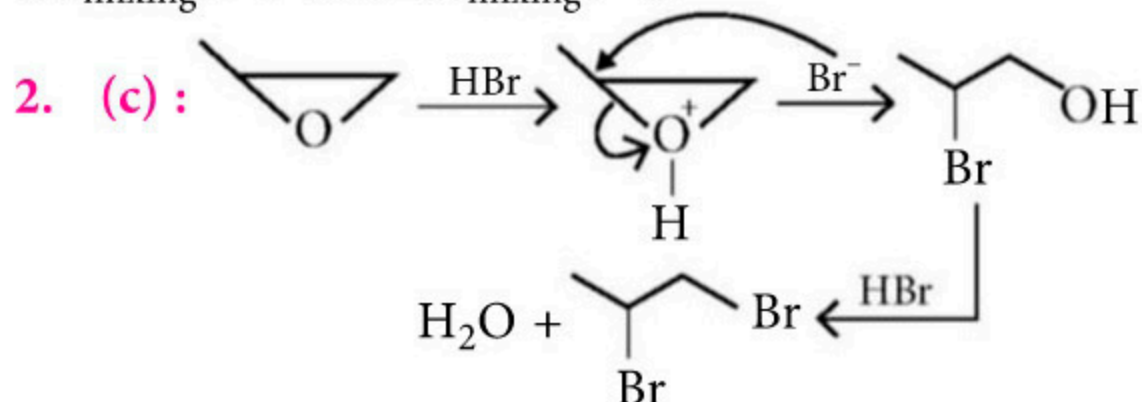
In this research, "It has been found that a continuous flow system that dramatically reduces the cost of both substrate and post synthesis process could impact on the future mass manufacture of single walled carbon nanotubes."



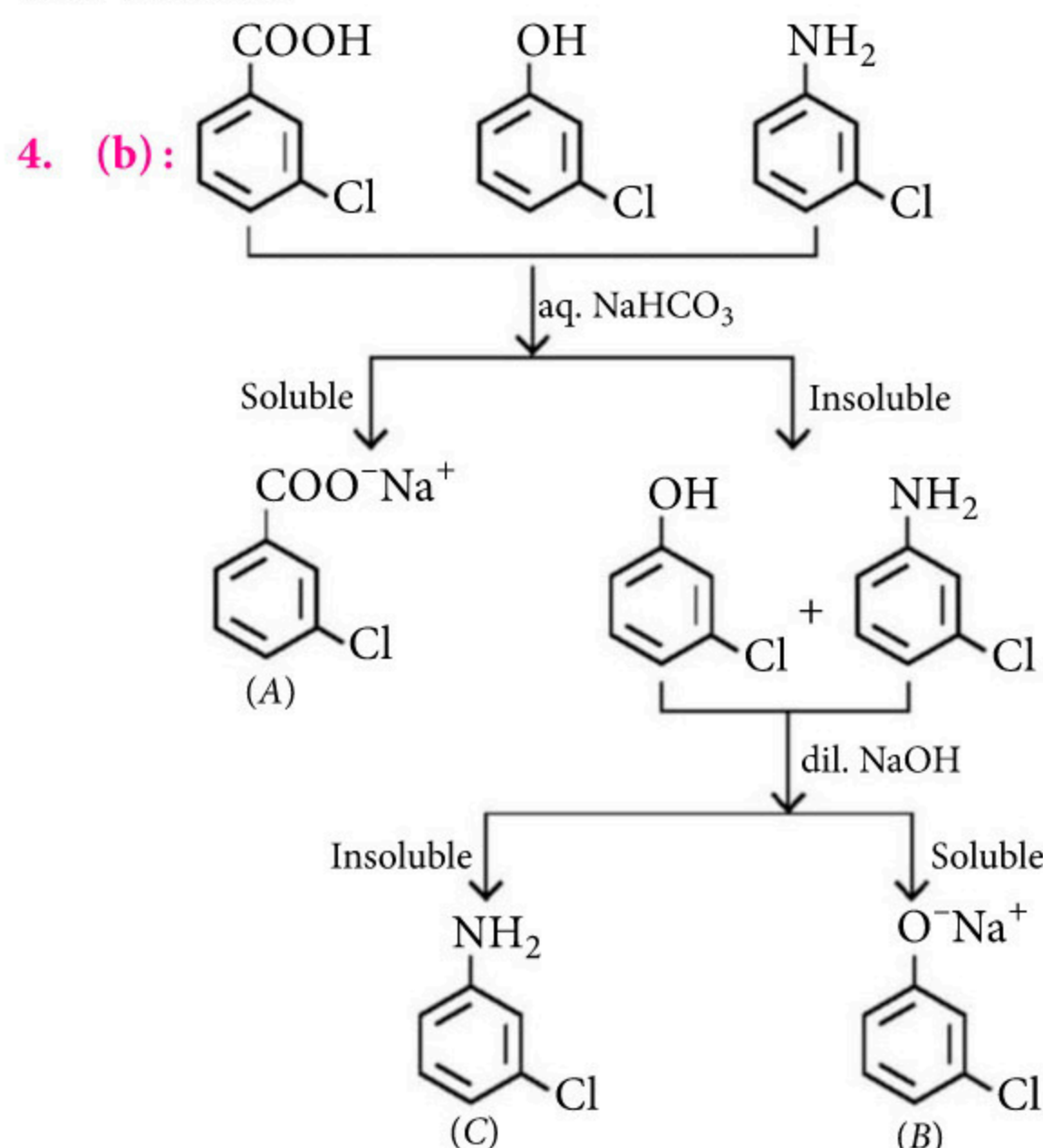
18. The relative strength of interionic/intermolecular forces in decreasing order is  
 (a) ion-dipole > dipole-dipole > ion-ion  
 (b) ion-ion > ion-dipole > dipole-dipole  
 (c) ion-dipole > ion-ion > dipole-dipole  
 (d) dipole-dipole > ion-dipole > ion-ion.
19. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is  
 (a) less efficient as the resins cannot be regenerated  
 (b) less efficient as it exchanges only anions  
 (c) more efficient as it can exchange only cations  
 (d) more efficient as it can exchange both cations as well as anions.
20. Oxidation number of potassium in  $K_2O$ ,  $K_2O_2$  and  $KO_2$ , respectively, is  
 (a) +1, +1 and +1 (b) +2, +1 and  $+\frac{1}{2}$   
 (c) +1, +2 and +4 (d) +1, +4 and +2.
21. Two solutions A and B, each of 100 L was made by dissolving 4 g of NaOH and 9.8 g of  $H_2SO_4$  in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is \_\_\_\_\_.
22. The number of chiral carbons in chloramphenicol is \_\_\_\_\_.
23. For the reaction ;  $A_{(l)} \longrightarrow 2B_{(g)}$   
 $\Delta U = 2.1 \text{ kcal}$ ,  $\Delta S = 20 \text{ cal K}^{-1}$  at 300 K.  
 Hence,  $\Delta G$  in kcal is \_\_\_\_\_.
24. During the nuclear explosion, one of the products is  $^{90}\text{Sr}$  with half-life of 6.93 years. If  $1 \mu\text{g}$  of  $^{90}\text{Sr}$  was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically \_\_\_\_\_.
25. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is \_\_\_\_\_.

### SOLUTIONS

1. (b): Mixture of pure  $\text{CS}_2$  and  $\text{CH}_3\text{COCH}_3$  shows positive deviation from Raoult's law. For such solution,  $\Delta V_{\text{mixing}} > 0$  and  $\Delta H_{\text{mixing}} > 0$ .



Methyl orange is widely used as an indicator in acid-base titration.



5. (a)
6. (c): Statement (c) is Gay Lussac's law of gaseous volumes.
7. (a): Atomic radius of Ag (144 pm) and Au (144 pm) are same.
8. (b)
9. (a): Molecular orbital theory properly explains the nature of bonding in  $[\text{Ni}(\text{CO})_4]$ .

10. (b)

11. (a): Dipole moment ( $\mu$ ) is zero for symmetrical molecules i.e.,  $\mu_{\text{CCl}_4} = \mu_{\text{CH}_4} = 0$  but  $\mu_{\text{CHCl}_3} > 0$ .

12. (b):  $\text{Cu}^{2+} + e^- \longrightarrow \text{Cu}^+$ ;  $\Delta G_1 = -nFE_1^\circ$   
 $= -1 \times F \times E_1^\circ$

$\text{Cu}^+ + e^- \longrightarrow \text{Cu}$ ;  $\Delta G_2 = -1 \times F \times 0.522$

$\text{Cu}^{2+} + 2e^- \longrightarrow \text{Cu}$ ;  $\Delta G_3 = -2 \times F \times 0.34$

Now,  $\Delta G_3 = \Delta G_1 + \Delta G_2$

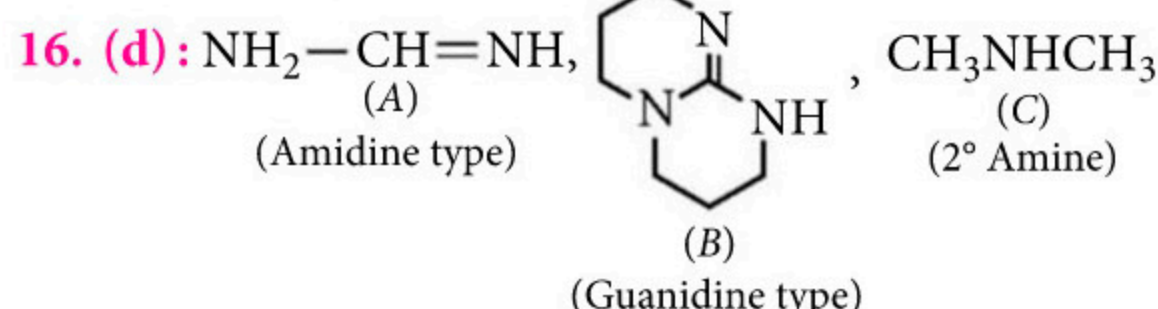
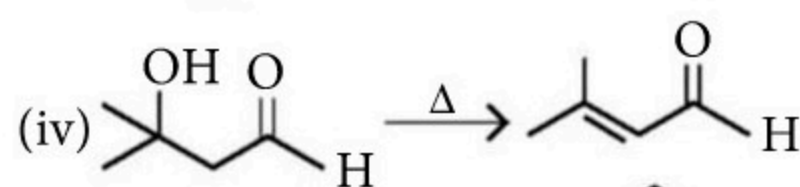
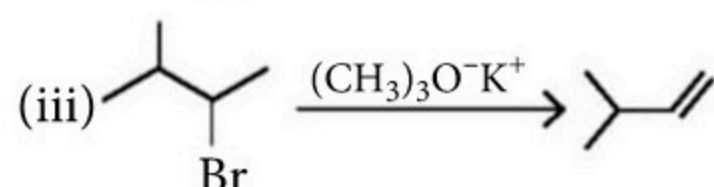
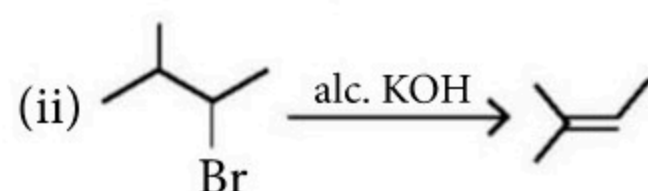
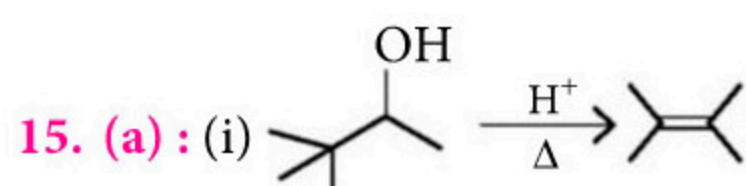
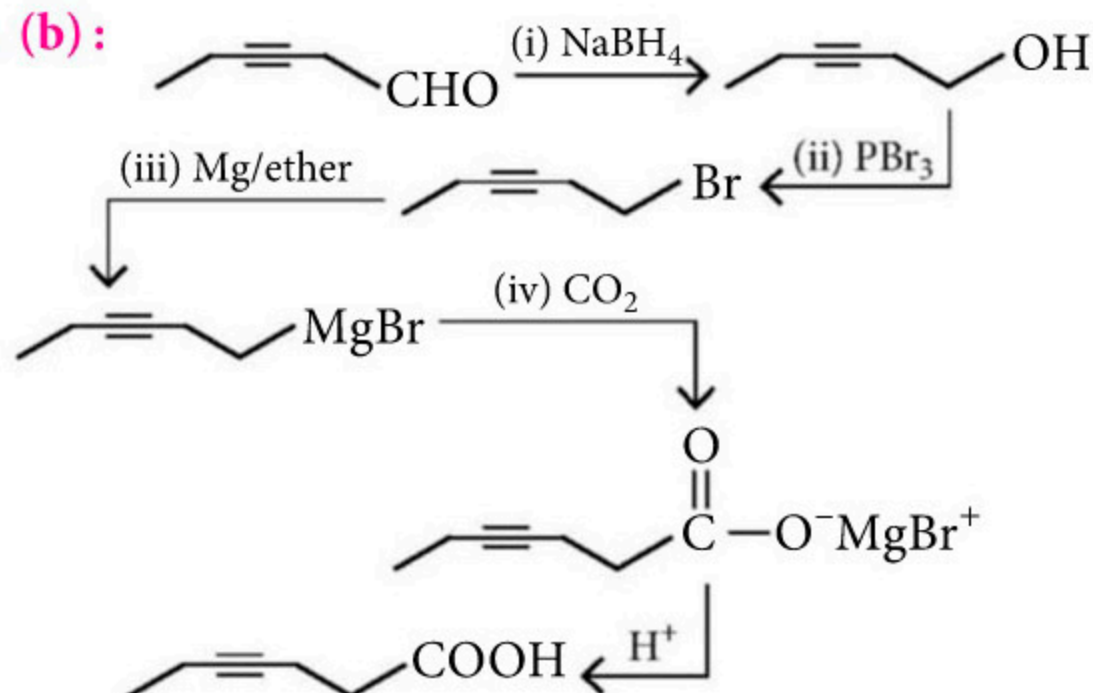
$-2 \times F \times 0.34 = -FE_1^\circ - 0.522F$

$E_1^\circ = +0.158 \text{ V}$



13. (a)

14. (b):



Amidines and guanidines are very strong bases, 100-1000 times stronger than tertiary amines due to very favourable resonance structures of their protonated forms. The conjugate acid of guanidine is most resonance stabilised followed by amidine.

$\therefore$  Order of basicity:  $B > A > C$

Order of  $\text{p}K_b$ :  $C > A > B$

17. (a): Total no. of electrons in  $n = 5$  are  $2n^2$  i.e.,  $2 \times 5^2 = 50$

Thus, electrons having,  $m_s = +\frac{1}{2} = \frac{50}{2} = 25$  which is equal to no. of orbitals.

18. (b)

19. (d)

20. (a): For  $\text{K}_2\text{O}$ :  $2x - 2 = 0 \Rightarrow x = +1$

For  $\text{K}_2\text{O}_2$ :  $2x - 2 = 0 \Rightarrow x = +1$

(In peroxide, the O.S. of Oxygen is  $-1$ .)

For  $\text{KO}_2$ :  $x - 2 \times \frac{1}{2} = 0 \Rightarrow x = +1$

(In superoxide, the O.S. of oxygen is  $-\frac{1}{2}$ .)

21. (10.60):  $M_{\text{H}_2\text{SO}_4} = \frac{9.8}{98 \times 100} = 10^{-3}$

$M_{\text{NaOH}} = \frac{4}{40 \times 100} = 10^{-3}$

$\text{H}_2\text{SO}_4 + 2\text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

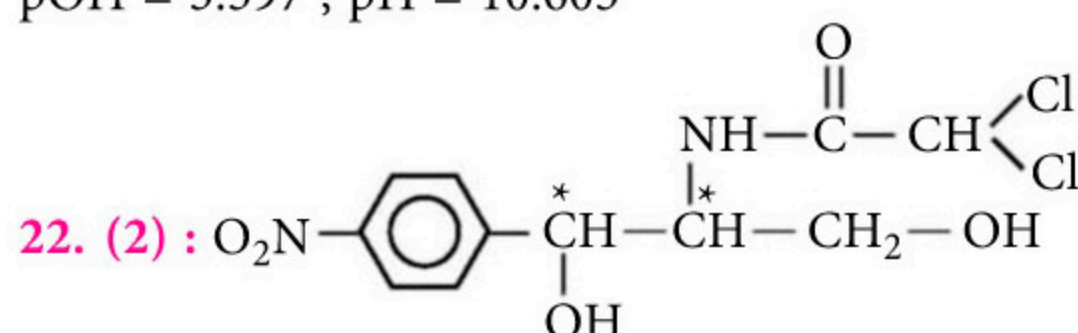
Concentration of resultant solution after neutralisation

$$= \frac{40 \times 10^{-3} - 10 \times 10^{-3} \times 2}{50} = \frac{20}{50} \times 10^{-3}$$

As NaOH is in excess therefore, resultant solution will be alkaline.

$$\therefore [\text{OH}^-] = \frac{2}{5} \times 10^{-3}$$

$$\text{pOH} = 3.397; \text{pH} = 10.603$$



23. (-2.7): We know that,

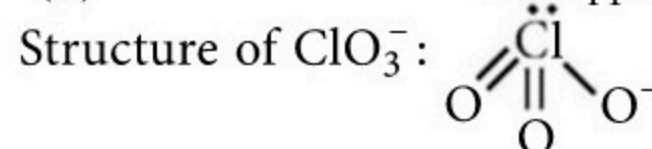
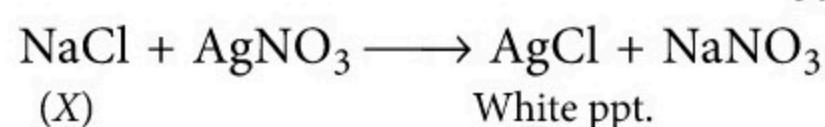
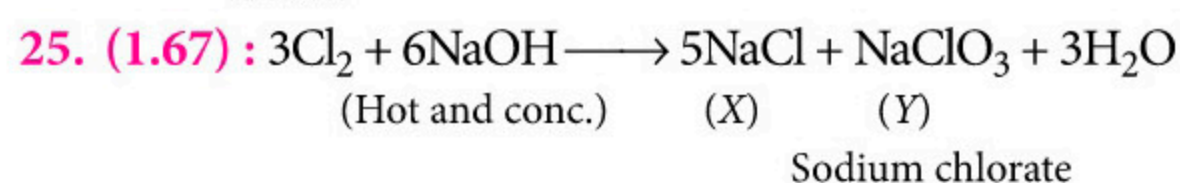
$$\begin{aligned}
 \Delta H &= \Delta U + \Delta n_g RT \\
 &= 2.1 \times 10^3 + 2(2)(300) = 2100 + 1200 = 3300 \text{ cal} \\
 \Delta G &= \Delta H - T\Delta S \\
 &= 3300 - (300)(20) = 3300 - 6000 \\
 &= -2700 \text{ cal} = -2.7 \text{ kcal}
 \end{aligned}$$

24. (23.03):  $t_{90\%} = \frac{1}{k} \ln \frac{a}{(a-x)} = \frac{1}{k} \ln \frac{100}{10} = \frac{\ln 10}{k}$

$$t_{50\%} = \frac{1}{k} \ln \frac{a}{(a-x)} = \frac{1}{k} \ln \frac{100}{50} = \frac{\ln 2}{k}$$

$$\frac{t_{90\%}}{t_{50\%}} = \frac{\ln 10/k}{\ln 2/k}$$

$$t_{90\%} = \frac{6.93 \times \ln 10}{0.693} = 23.03 \text{ years}$$



Bond order between Cl and O in  $\text{ClO}_3^-$

$$= \frac{\text{Total bonds}}{\text{Total sigma bonds}} = \frac{5}{3} = 1.67$$



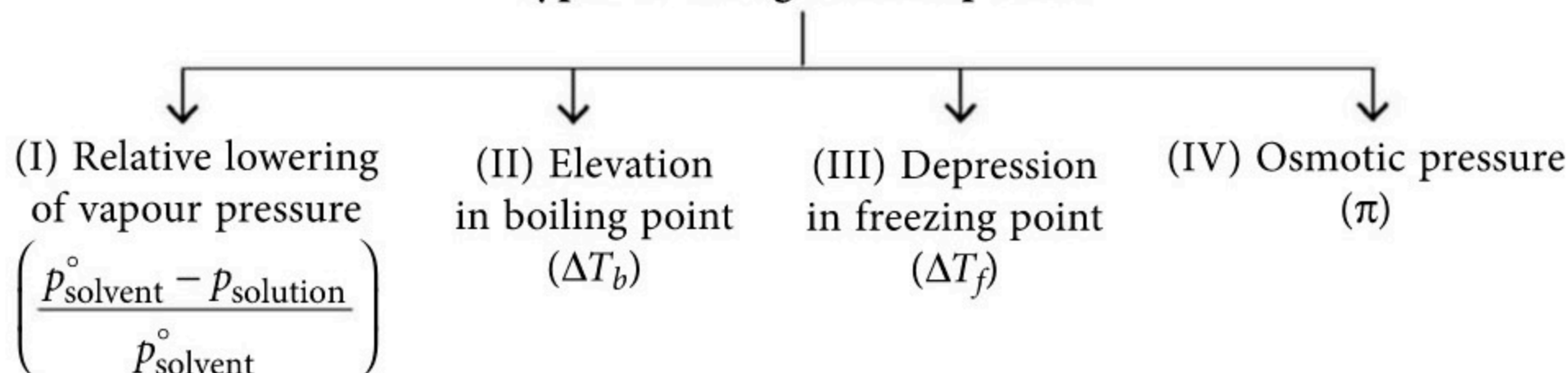
# Rank Enhancer

This column is specially designed to make your concepts crystal clear.

## Colligative properties

Properties of solution which depends on number of particles but not on the nature of solute are known as colligative properties.

### Types of Colligative Properties



**Note :** Colligative properties are properties of only dilute solutions as they only behave as ideal solutions.

### I. Relative Lowering of Vapour Pressure

When a non-volatile solute is added to a volatile solvent, its vapour pressure decreases. Such decrease with respect to vapour pressure of solvent is called relative lowering of vapour pressure.

$$\frac{P_{\text{solvent}}^{\circ} - P_{\text{solution}}}{P_{\text{solvent}}^{\circ}} = X_{\text{solute}}$$

According to Raoult's law for ideal solutions

$$P_{\text{solution}} = P_A^{\circ} X_A + P_B^{\circ} X_B$$

[B = Solute (non-volatile), A = Solvent (volatile)]

$$P_B^{\circ} = 0 \text{ as solute is non-volatile}$$

$$\text{and } X_A + X_B = 1 \Rightarrow X_A = 1 - X_B$$

$$P_{\text{solution}} = P_A^{\circ}(1 - X_B) + 0 \times X_B$$

$$P_{\text{solution}} = P_A^{\circ} - P_A^{\circ} \times X_B$$

$$P_A^{\circ} X_B = P_A^{\circ} - P_{\text{solution}}$$

$$X_B = \frac{P_A^{\circ} - P_{\text{solution}}}{P_A^{\circ}}$$

$$\text{or } \frac{P_{\text{solvent}}^{\circ} - P_{\text{solution}}}{P_{\text{solvent}}^{\circ}} = X_{\text{solute}}$$

$$\frac{P_{\text{solvent}}^{\circ} - P_{\text{solution}}}{P_{\text{solvent}}^{\circ}} = \frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}}$$

For dilute solution,  $n_{\text{solute}} \ll n_{\text{solvent}}$

$$\therefore \frac{P_{\text{solvent}}^{\circ} - P_{\text{solution}}}{P_{\text{solvent}}^{\circ}} = \frac{n_{\text{solute}}}{n_{\text{solvent}}}$$

$$\frac{P_{\text{solvent}}^{\circ} - P_{\text{solution}}}{P_{\text{solvent}}^{\circ}} = \frac{w_{\text{solute}} \times M_{\text{solvent}}}{w_{\text{solvent}} \times M_{\text{solute}}}$$

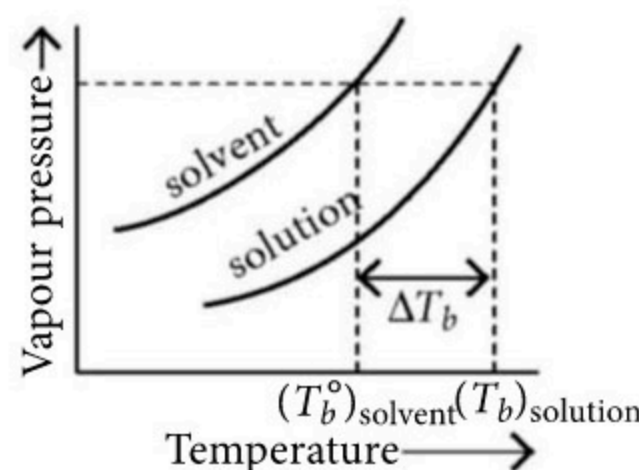
### II. Elevation in Boiling Point

When a non-volatile solute is added to volatile solvent, resulting solution will have less vapour pressure. Hence, boiling point will increase. Such increase in boiling point is called elevation in boiling point. It is represented by  $\Delta T_b$ .

$$\Delta T_b = (T_b)_{\text{solution}} - (T_b^{\circ})_{\text{solvent}}$$

$$= K_b \times m = K_b \times \frac{(\text{wt. / m.wt.})_{\text{solute}}}{(\text{wt. of solvent in g})} \times 1000$$

where,  $K_b$  = Ebullioscopic constant or molal elevation constant.



### Expression for molal elevation constant from enthalpy of vaporisation :

$$K_b = \frac{RT_b^{\circ 2}}{1000 \times L_v}$$

$R$  = Universal gas constant

$T_b^{\circ}$  = Boiling point of solvent

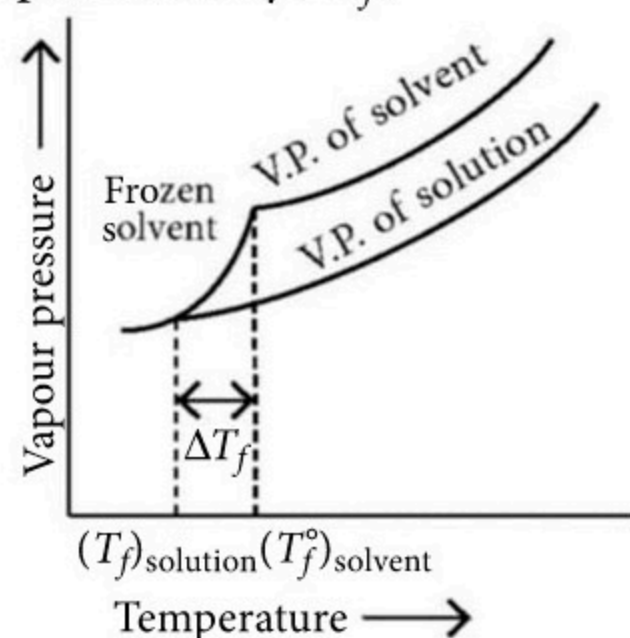
$L_v$  = Latent heat of vaporisation

By K. Vijay Bhasker, Senior faculty at Sri Chaitanya Educational Institution, Visakhapatnam



### III. Depression in Freezing Point

Since vapour pressure of solution is lower than solvent, solid form separates out at a lower temperature. Such decrease in freezing point is called depression in freezing point. It is represented by  $\Delta T_f$ .



$$\Delta T_f = (T_f^\circ)_{\text{solvent}} - (T_f)_{\text{solution}} = K_f \times m$$

$$= K_f \times \frac{(\text{wt. / mol. wt.})_{\text{solute}}}{(\text{wt. of solvent in g})} \times 1000$$

where,  $K_f$  = Cryoscopic constant or molal depression constant.

### Expression for molal depression constant from enthalpy of fusion

$$K_f = \frac{RT_f^{\circ 2}}{1000 \times L_f}$$

where,  $R$  is universal gas constant.  $T_f^\circ$  is freezing point of the solvent,  $L_f$  is latent heat of fusion.

### IV. Osmotic Pressure

The process of flow of solvent from low concentrated solution/solvent to more concentrated solution through a semipermeable membrane is called osmosis.

The external pressure required to stop osmosis is called osmotic pressure.

### Isotonic, Hypertonic and Hypotonic solutions

- If two solutions have same osmotic pressures then they are called isotonic solutions.
- If two solutions have different osmotic pressures, then the solution with higher osmotic pressure is called hypertonic and solution with lower osmotic pressure is called hypotonic solution.

### Exo-osmosis and Endo-osmosis

The outward flow of solvent from cell is called exo-osmosis and the net inward flow of solvent into the cell is called endo-osmosis.

e.g., Grapes in water  $\Rightarrow$  Endo-osmosis

Grapes in sugar solution  $\Rightarrow$  Exo-osmosis

$$\text{Osmotic pressure } (\pi) = C \times S \times T$$

$C$  = Concentration of solution

$S$  = Universal solution constant

$T$  = Temperature in Kelvin

### Colligative Properties for Abnormal Solutions

Certain solutes show abnormal molecular masses either due to dissociation or association. Such solutions are called abnormal solutions. They are identified by van't Hoff factor ( $i$ ).

$$i = \frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$$

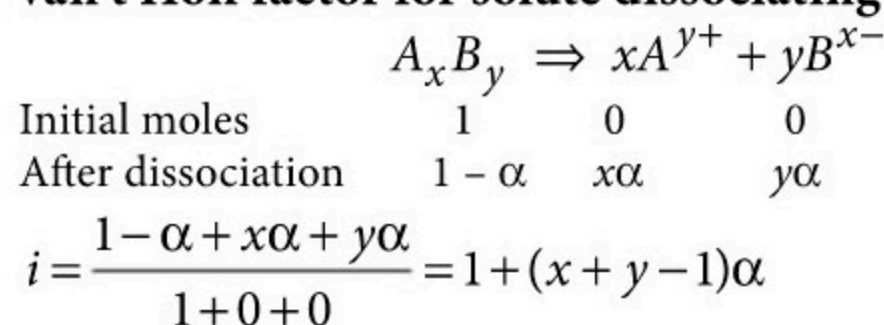
$$= \frac{\text{Observed colligative property}}{\text{Normal colligative property}}$$

$$= \frac{\text{Number of moles after dissociation/association}}{\text{Number of moles dissolved}}$$

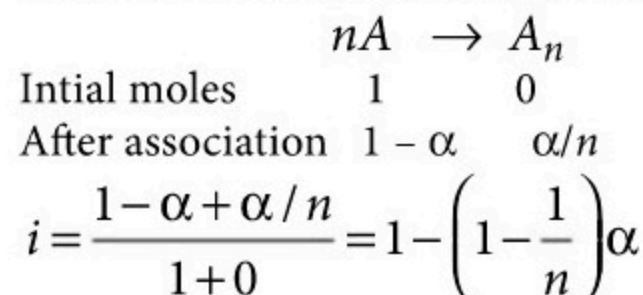
If  $i = 1$ , solution is not abnormal i.e., solute neither dissociates nor associates, e.g., sucrose, glucose and urea. If  $i > 1$ , solution is abnormal due to dissociation of solute, e.g., NaCl,  $\text{CaCl}_2$ ,  $\text{K}_4[\text{Fe}(\text{CN})_6]$ , etc.

If  $i < 1$ , solution is abnormal due to association of solute, e.g., benzoic acid in benzene.

### van't Hoff factor for solute dissociating :



### van't Hoff factor for solute associating :



### Modified Colligative Properties for Abnormal Solutions

- (1) Relative lowering of vapour pressure

$$= \frac{P_A^\circ - P_A}{P_A^\circ} = iX_B$$

- (2) Elevation in boiling point  $(\Delta T_b) = i \times K_b \times m$
- (3) Depression in freezing point  $(\Delta T_f) = i \times K_f \times m$
- (4) Osmotic pressure  $(\pi) = iCST$

### Some facts to be remembered

- Methods for measuring colligative properties :
  - Relative lowering of V.P. – Ostwald and Walker method
  - Elevation in B.Pt. – Landsberger method
  - Depression in F.Pt. – Beckmann method
  - Osmotic pressure – Berkely and Hartely method
- Osmotic pressure is the best method for determining molecular mass of polymer as in other colligative properties, observed values are too small and accuracy lost.



(III) Ethylene glycol ( $\text{CH}_2\text{OH} - \text{CH}_2\text{OH}$ ) is added to water before using in radiators because it is being non-volatile. It reduces freezing point thus avoid ice formation in winter. Hence called "antifreeze" and also increases boiling point thus avoids topping of radiator water in summer.

(IV) 0.9% solution of NaCl is isotonic with human RBC.

(V) Plasmolysis : Shrinking of plant cells when placed in hypertonic solutions.

### PROBLEMS

- If the observed and theoretical molecular mass of AB electrolyte is 31.80 and 58.50 respectively, then the degree of dissociation of AB is  
(a) 83.96% (b) 90% (c) 8.39% (d) 100%
- If all symbols have their usual meaning, then for non-volatile and non-electrolyte solute, the value of  $\lim_{m \rightarrow 0} \left[ \frac{\Delta T_b}{m} \right]$  is  
(a) infinity (b) zero  
(c)  $\Delta T_b$  (d)  $K_b$ .
- If two elements P and Q form compounds of molecular formulae  $\text{PQ}_2$  and  $\text{PQ}_4$ . When 1 g of  $\text{PQ}_2$  dissolved in 20 g of  $\text{C}_6\text{H}_6$  then decrease in freezing point by 2.3 K. But when 1 g of  $\text{PQ}_4$  dissolved in 20 g of  $\text{C}_6\text{H}_6$ , it decreases the freezing point by 1.3 K. Atomic masses of P and Q are ( $K_f$  of benzene is  $5.1 \text{ K m}^{-1}$ ).  
(a) 25.58 and 42.64 (b) 22.64 and 55.58  
(c) 42.64 and 25.58 (d) 45.64 and 22.58.
- If  $K_b/K_f$  of electrolyte AB is 0.3 and its aq. solution is 100% ionised and have boiling point  $101.08^\circ\text{C}$ . If the freezing point of same solution is  $-1.80^\circ\text{C}$  then AB is  
(a) 100% ionised at freezing point also  
(b) no ionisation at freezing point  
(c) 50% ionised at freezing point  
(d) dimerisation takes place at freezing point.
- If  $\text{p}K_a$  of monobasic acid HA is 4 then its van't Hoff factor of 0.01 M solution is  
(a) 1.10 (b) 1.01 (c) 1.20 (d) 1.02
- If osmotic pressure of solution of insulin at 298 K is found to be  $7.2 \times 10^{-3} \text{ atm}$  then height of water column due to this osmotic pressure is (Density of Hg =  $13.6 \text{ g/cm}^3$ )  
(a) 760 mm (b) 70.28 mm  
(c) 74.42 mm (d) 0.76 mm.



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If you have taken any of the exams given below and possess plenty of grey cells and photographic memory then you are the right candidate for this contest. All you have to do is write down as many questions (with all choices) you can remember, neatly on a paper with name of the exam, your name, address, age, your photograph and mail them to us.

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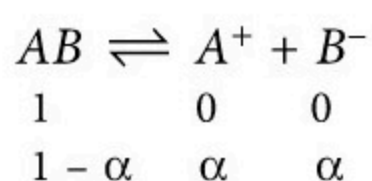


7. 1 m aq. urea solution freezes at  $-1.86^{\circ}\text{C}$  and 0.01 M aq. acetic acid solution freezes at  $-0.02046^{\circ}\text{C}$ . The pH of acetic acid is (assuming  $m = M$ )  
 (a) 3 (b) 3.2 (c) 4.2 (d) 2
8. van't Hoff factor of very dilute phosphorous acid is  
 (a) 7 (b) 8 (c) 4 (d) 3
9. Which of the following is not a colligative property?  
 (a) Boiling point elevation  
 (b) Lowering of vapour pressure  
 (c) Osmotic pressure  
 (d) Decrease in freezing point
10. Which of the following have lowest freezing point?  
 (a) 0.2 m NaCl (b) 0.2 m glucose  
 (c) 0.2 m sucrose (d) 0.2 m  $\text{BaCl}_2$

### SOLUTIONS

1. (a) : van't Hoff factor ( $i$ ) =  $\frac{MM_{\text{theoretical}}}{MM_{\text{experimental}}}$   

$$= \frac{58.50}{31.80} = 1.8396$$



$$i = \frac{1 + \alpha}{1} = 1.8396 \Rightarrow \alpha = 0.8396 \text{ or } 83.96\%$$

2. (d) : Given,  $\lim_{m \rightarrow 0} \left[ \frac{\Delta T_b}{m} \right]$

According to elevation in boiling point,

$$\Delta T_b = i \times K_b \times m$$

But  $\frac{\Delta T_b}{m} = K_b$  ( $i = 1$ , For non-electrolyte)

$$\therefore \lim_{m \rightarrow 0} \left[ \frac{\Delta T_b}{m} \right] = \lim_{m \rightarrow 0} (K_b) = K_b$$

3. (a) :  $(\Delta T_f)_{PQ_2} = K_f \times m$

$$\Rightarrow 2.3 = 5.1 \times \left( \frac{1}{P + 2Q} \right) \times 1000$$

$$P + 2Q = \frac{51 \times 50}{23} \quad \dots (1)$$

$$(\Delta T_f)_{PQ_4} = K_f \times m \Rightarrow 1.3 = 5.1 \times \left( \frac{1}{P + 4Q} \right) \times 1000$$

$$P + 4Q = \frac{51 \times 50}{13} \quad \dots (2)$$

From eq. (1) and (2),  $P = 25.58$  and  $Q = 42.64$

4. (c) :  $\frac{\Delta T_b}{\Delta T_f} = \frac{i \times K_b \times m}{i \times K_f \times m}$

Given;  $\Delta T_b = 101.08 - 100 = 1.08$

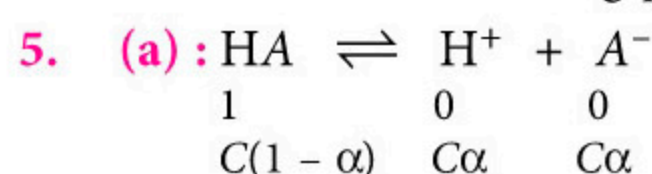
$\Delta T_f = 0 - (-1.80) = 1.80$  and  $K_b/K_f = 0.3$

$$\frac{1.08}{1.80} = \frac{i_{B.Pt.}}{i_{F.Pt.}} \times 0.3 \times 1$$

As AB is 100% ionised therefore its  $i_{B.Pt.} = 2$

$$i_{F.Pt.} = \frac{2 \times 0.3 \times 1.8}{1.08} = 1$$

$\therefore$  50% ionised at freezing point.



$$K_a = C\alpha^2$$

$$10^{-4} = 10^{-2} \times \alpha^2 \Rightarrow \alpha = 0.1$$

For HA,  $i = 1 + \alpha = 1 + 0.1 = 1.1$

6. (c) :  $\rho = h \times d \times g$

For 1 atm = 760 mm of Hg

Given,  $7.2 \times 10^{-3} \equiv 7.2 \times 10^{-3} \times 760 \text{ mm of Hg}$

$$\rho_{H_2O} = \rho_{Hg}$$

$$(hdg)_{H_2O} = (hdg)_{Hg}$$

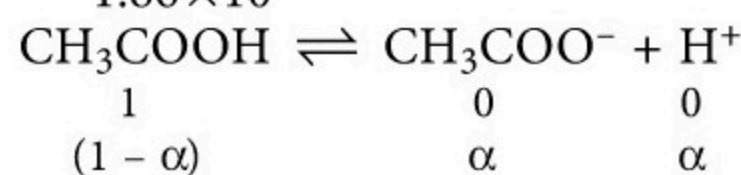
$$h \times 1 \times 9.8 = (7.2 \times 10^{-3} \times 760) \times 13.6 \times 9.8$$

$$h = 74.42 \text{ mm of Hg}$$

7. (a) :  $\frac{(\Delta T_f)_{\text{urea}}}{(\Delta T_f)_{\text{acetic acid}}} = \frac{(i \times K_f \times m)_{\text{urea}}}{(i \times K_f \times m)_{\text{acetic acid}}}$

$$\frac{1.86}{0.02046} = \frac{1 \times K_{f_{\text{urea}}} \times 1}{i \times K_{f_{\text{acetic acid}}} \times 10^{-2}}$$

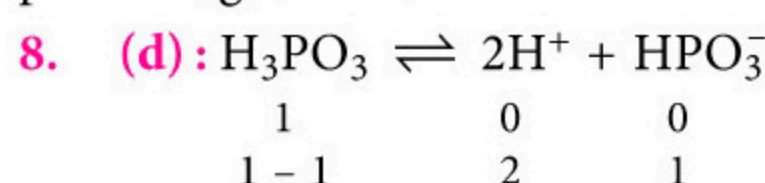
$$i = \frac{0.02046}{1.86 \times 10^{-2}} = 1.1$$



$$i = 1 + \alpha = 1.1 \Rightarrow \alpha = 0.1$$

$$\therefore [H^+] = C\alpha = 10^{-2} \times 10^{-1} = 10^{-3}$$

$$\text{pH} = -\log 10^{-3} = 3$$



$$i = \frac{3}{1} = 3$$

9. (b) : Relative lowering of vapour pressure is a colligative property but not lowering of vapour pressure.

10. (d) :  $\text{BaCl}_2$  have highest  $i$  (i.e., 3)

$\therefore$  Freezing point is lowest.

$$\left\{ \text{freezing point} \propto \frac{1}{i} \text{ if 'm' is same.} \right\}$$





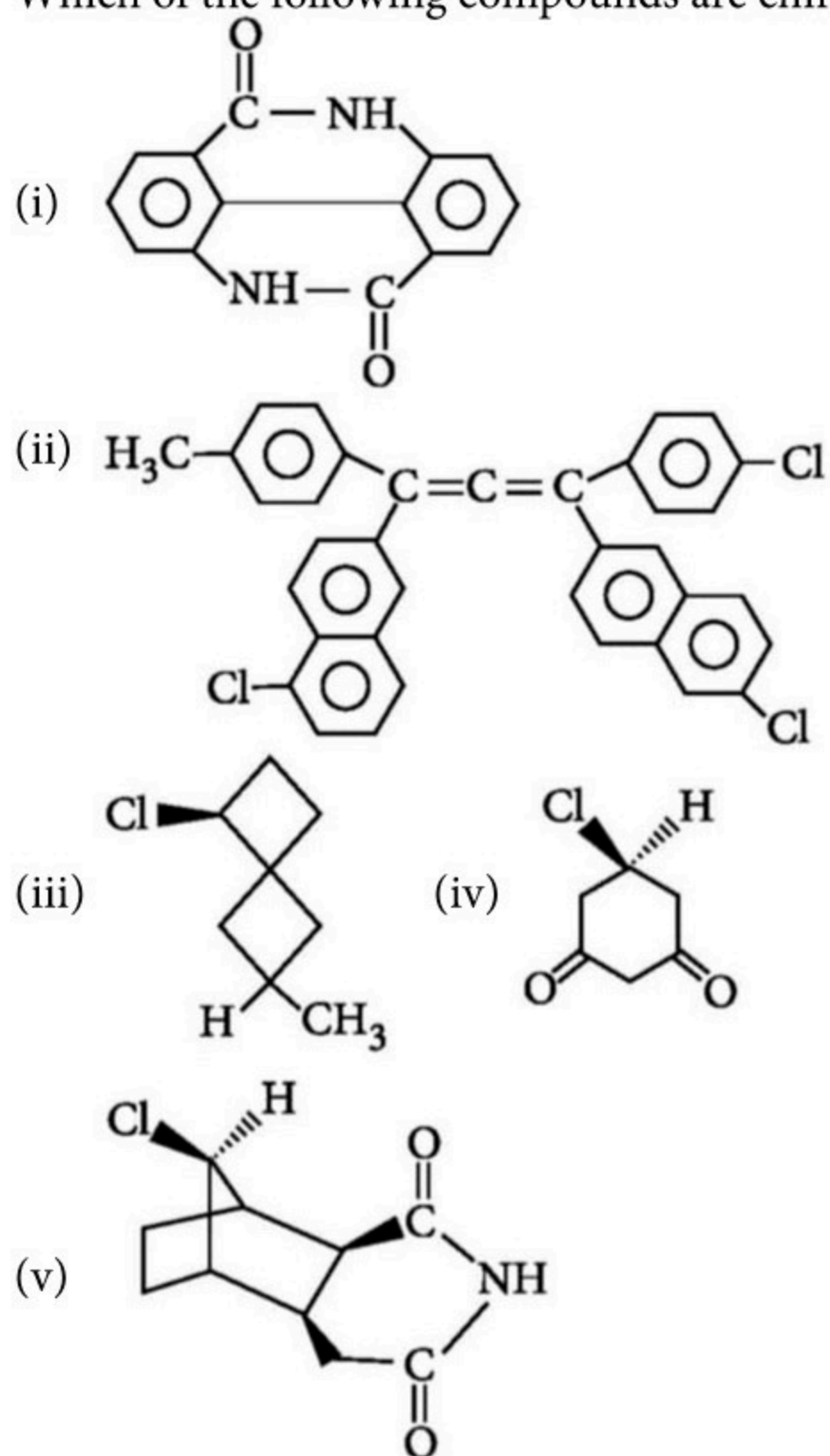
# CONCEPT BOOSTER

**Hello Students!!** Hope your first JEE Main has gone well and those for whom exam has not gone well, they have at least identified their flaws and have already started working on that. Now the forthcoming exams are your main points of attention. So start working with full strategy. As your friend I am always there beside you and in this article I have presented 15 questions which are important as well as concept based. Ideal time to solve this paper is 25 minutes. Hope you will like it.

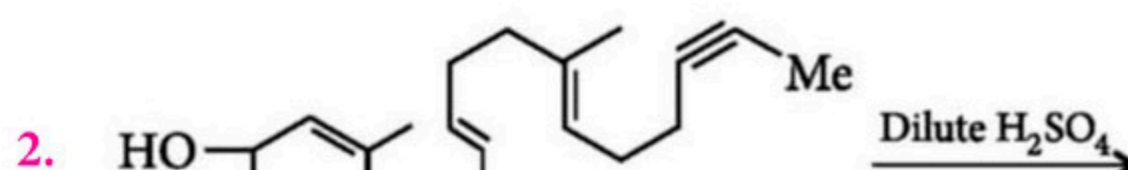
\*Arunava Sarkar

## SINGLE CORRECT OPTION

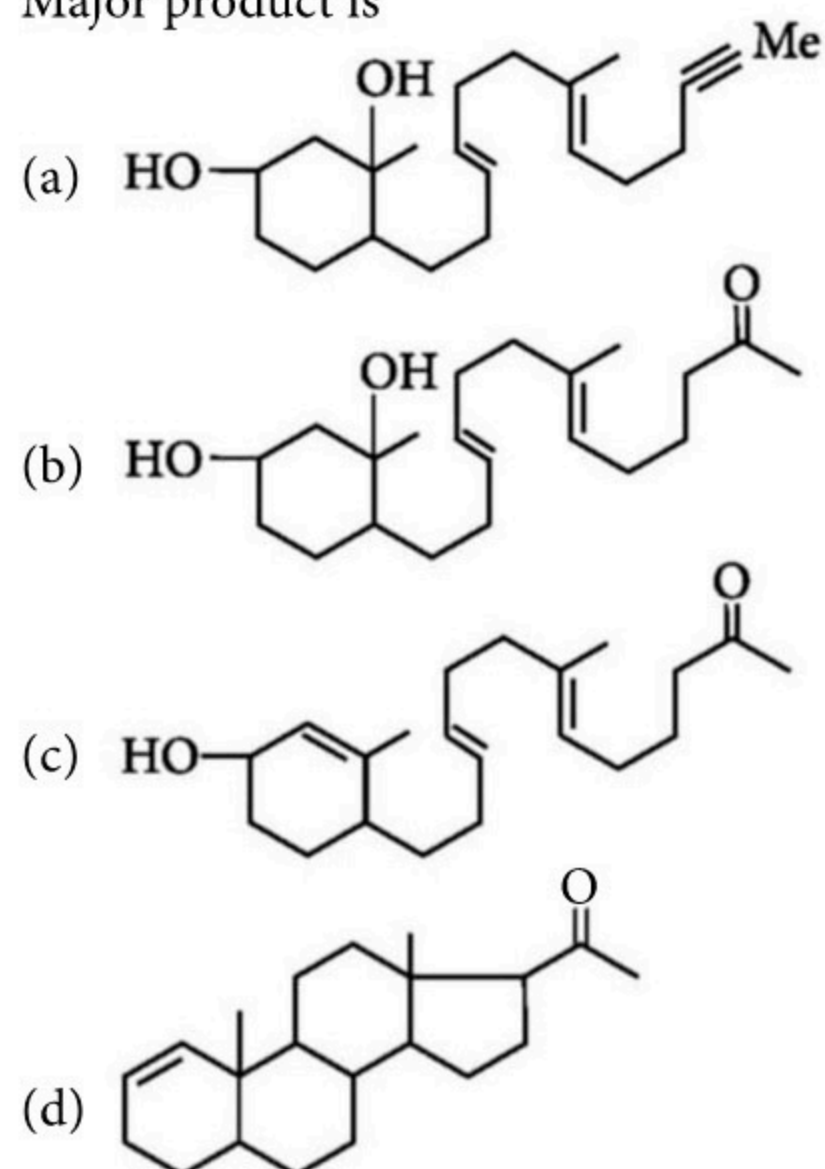
1. Which of the following compounds are chiral?



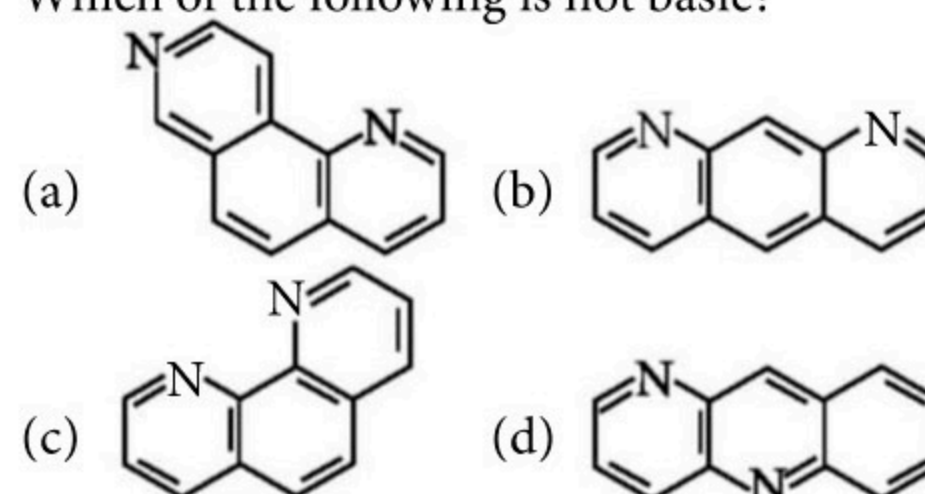
- (a) i, ii, iii, iv  
(b) ii, iii, iv, v  
(c) i, iv, v  
(d) None of these



Major product is



3. Which of the following is not basic?





4. The increasing order of atomic radii of the following group 13 elements is

- (a)  $\text{Al} < \text{Ga} < \text{In} < \text{Tl}$  (b)  $\text{Ga} < \text{Al} < \text{In} < \text{Tl}$   
(c)  $\text{Al} < \text{In} < \text{Ga} < \text{Tl}$  (d)  $\text{Al} < \text{Ga} < \text{Tl} < \text{In}$

5. Which is the correct order of melting point?

- (a)  $\text{NH}_3 > \text{PH}_3 > (\text{CH}_3)_3\text{N}$   
(b)  $(\text{CH}_3)_3\text{N} > \text{NH}_3 > \text{PH}_3$   
(c)  $\text{NH}_3 > (\text{CH}_3)_3\text{N} > \text{PH}_3$   
(d)  $\text{PH}_3 > (\text{CH}_3)_3\text{N} > \text{NH}_3$

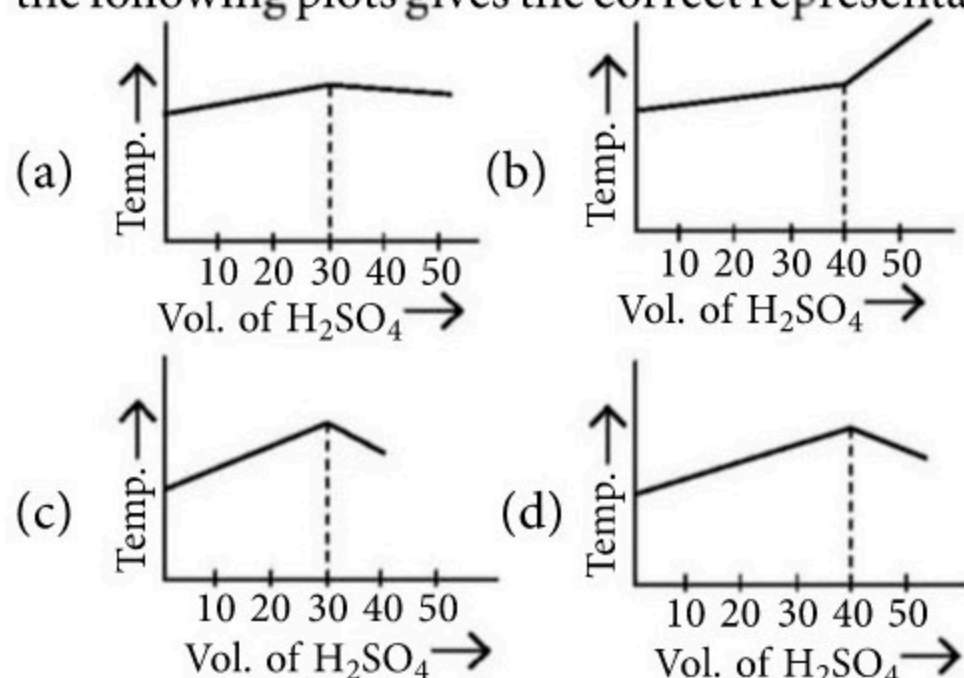
6. What is the atmospheric pressure (in atm) at  $15^\circ\text{C}$  on a mountain that stands 2500 m above the sea level, given that the pressure on the ground level is 1 atm and that other conditions are negligible?

- (a) 0.42 (b) 1.92 (c) 0.48 (d) None

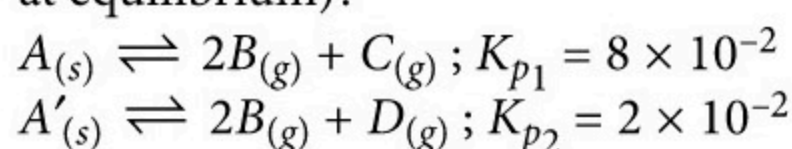
7. Which of the following statements is correct?

- (a)  $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V = R$   
(b)  $\left(\frac{\partial H}{\partial T}\right)_P > \left(\frac{\partial U}{\partial T}\right)_V$   
(c)  $\left(\frac{\partial U}{\partial V}\right)_T$  for ideal gas is zero.  
(d) All of the above

8. In an experiment to determine the enthalpy of neutralisation of sodium hydroxide with sulphuric acid,  $40\text{ cm}^3$  of  $0.6\text{ M}$   $\text{NaOH}$  were titrated thermometrically with  $0.30\text{ M}$   $\text{H}_2\text{SO}_4$ . Which of the following plots gives the correct representation?



9. For given two equilibria attained in a container which is correct if degree of dissociation of A and A' are  $\alpha$  and  $\alpha'$  respectively ( $p'$  = partial pressure at equilibrium)?



(a)  $\frac{K_{p2}}{K_{p1}} = \left(\frac{3\alpha' + 2\alpha}{3\alpha + 2\alpha'}\right) \cdot \frac{\alpha}{\alpha'}$

(b)  $\frac{p'_C}{p'_D} = 4$

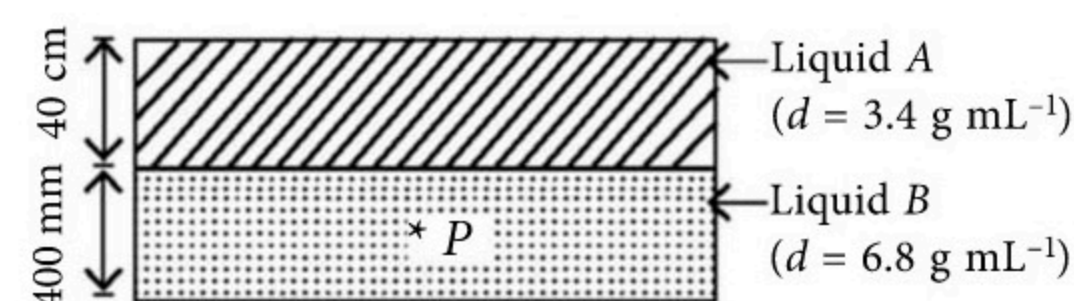
(c)  $p'_B = p'_C + p'_D$

(d)  $\alpha < \alpha'$

10. 500 mL of  $0.2\text{ M}$   $\text{Na}_2\text{SO}_4$  solution is mixed with 100 mL of  $17.1\%$  (w/v)  $\text{Al}_2(\text{SO}_4)_3$  solution and resulting solution is diluted to 5 times. Find the molarity of  $\text{SO}_4^{2-}$  ions in the final solution. (Atomic masses :  $\text{Al} = 27$ ,  $\text{S} = 32$ ,  $\text{Na} = 23$ )

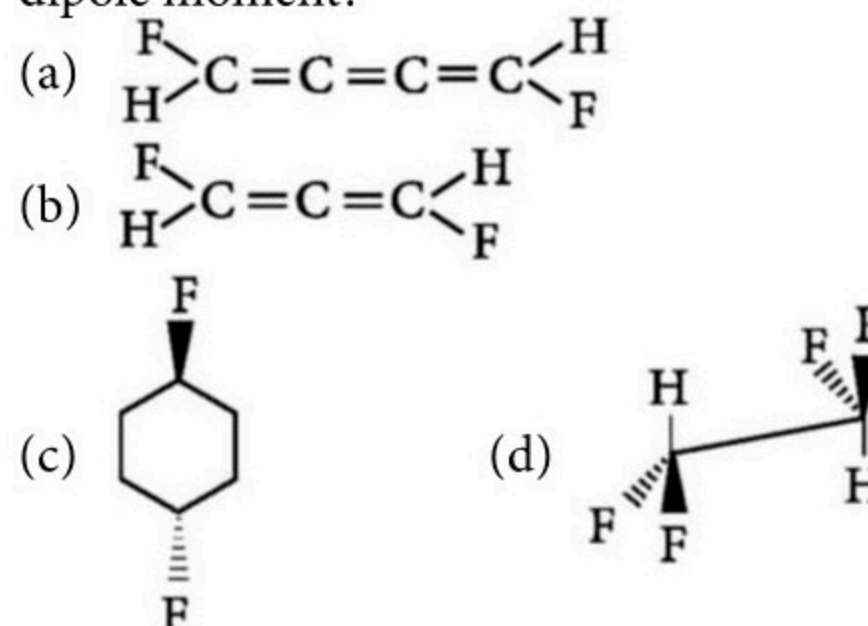
- (a)  $M/15$  (b)  $5M/12$   
(c)  $12M/5$  (d) None of these

11. Find pressure (in atm) at point P, 10 cm above the bottom of container.



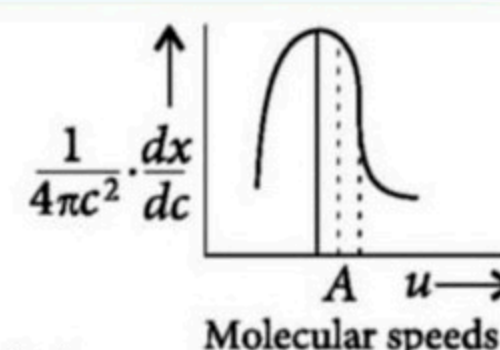
- (a) 91/76 (b) 156/76  
(c) 101/76 (d) None of these

12. Which of the following molecules doesn't have dipole moment?



### MORE THAN ONE CORRECT OPTIONS

13. The Maxwell-Boltzmann distribution law of molecular speeds is graphically represented as :

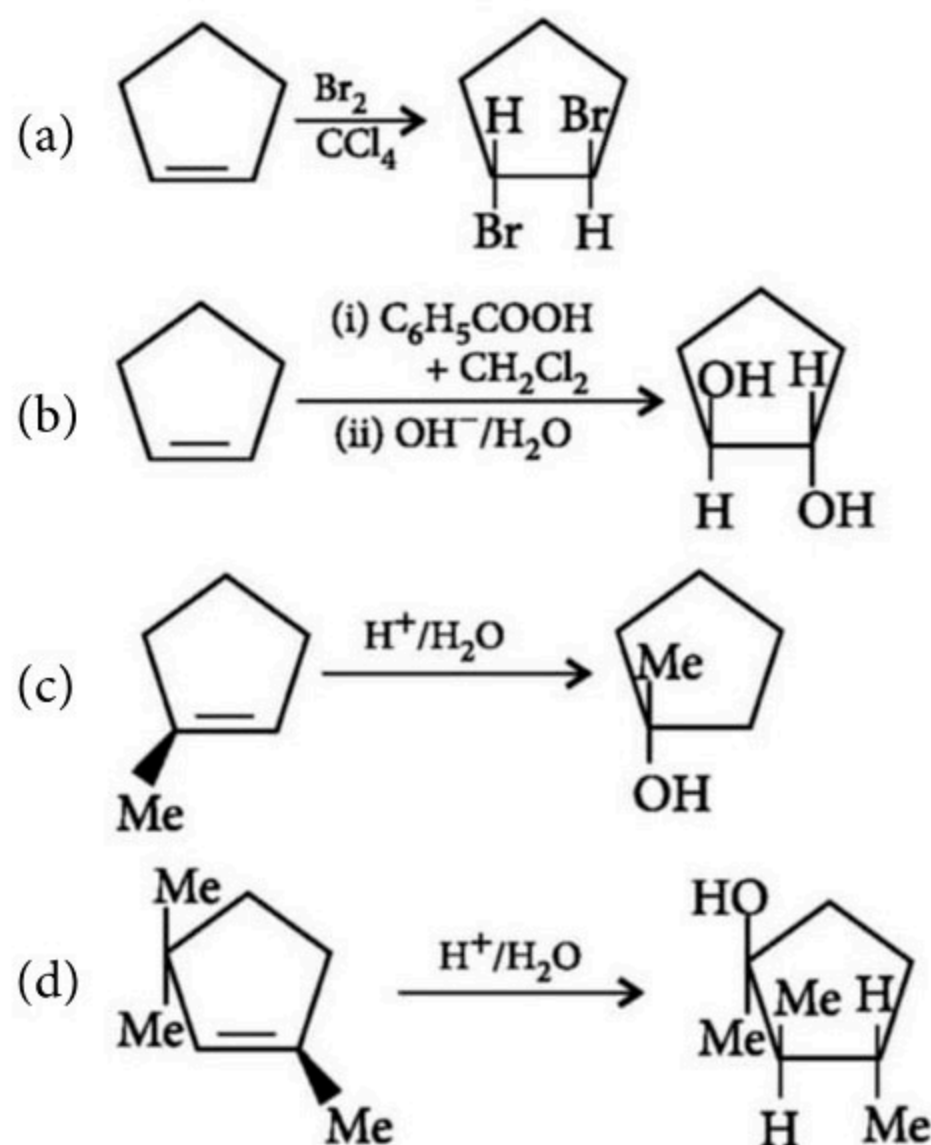


This curve has which of the following characteristics?

- (a) It has symmetrical distribution.  
(b) The point A on x-axis represents the most probable speed.  
(c) The area under the curve gives the total number of molecules.  
(d) The maximum shifts to the right as temperature increases.



14. Which of the following reactions are correct?

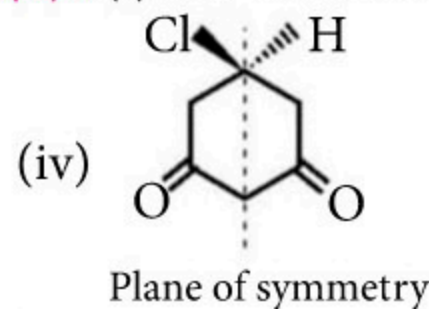


15. Which of the following represent correct order?

- (a) Polarity of M – H bond :  $\text{PH}_3 < \text{AsH}_3 < \text{SbH}_3 < \text{NH}_3$   
 (b) Bond angles :  $\text{NH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$   
 (c) Bond angles :  $\text{NO}_2^+ > \text{NO}_2 > \text{NO}_2^-$   
 (d) Stability :  $\text{H}_2 > \text{H}_2^+ = \text{H}_2^-$

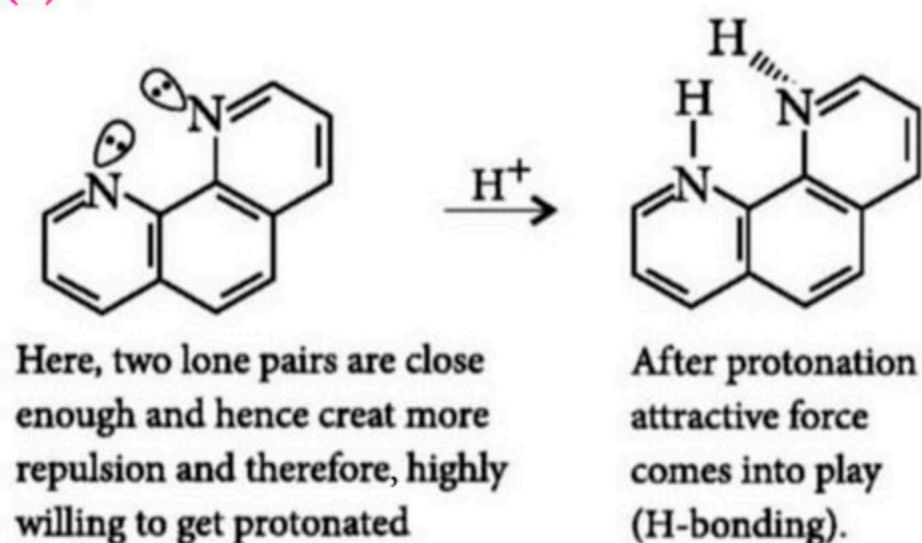
### SOLUTIONS

1. (d) : (i) has centre of symmetry.



2. (d) : First attack on the –OH group.

3. (c) :



4. (b) :  $r_{\text{Ga}} < r_{\text{Al}}$   
 (135 pm) (143 pm)

It is because of poor shielding of nuclear charge by 3d electrons. In and Tl follow regular trend.

5. (c) :  $\text{NH}_3 = -77.7^\circ\text{C}$ ,  $(\text{CH}_3)_3\text{N} = -117^\circ\text{C}$ ,  
 $\text{PH}_3 = -133^\circ\text{C}$

$\text{NH}_3$  has H-bonding.  $(\text{CH}_3)_3\text{N}$  has higher molar mass than  $\text{PH}_3$ .

6. (d) :  $2.203 \log \left( \frac{P_h}{P_o} \right) = -\frac{mgh}{RT}$

7. (d) :  $\left( \frac{\partial H}{\partial T} \right)_P = C_P$ ,  $\left( \frac{\partial U}{\partial T} \right)_V = C_V$

Again,  $\left( \frac{\partial U}{\partial V} \right)_T = 0$  for ideal gas.

8. (d) : Meq. of  $\text{NaOH} = (40 \times 0.6) = 24$

$\therefore$  Meq. of  $\text{H}_2\text{SO}_4$  needed = 24

If vol. of  $\text{H}_2\text{SO}_4$  needed = V mL

$V \times 0.3 \times 2 = 24 \Rightarrow V = 40 \text{ mL}$

$\therefore$  (d) is correct, as temperature increases during neutralisation and then decreases due to increase in volume of solution.

9. (b) :  $A_{(s)} \rightleftharpoons 2B_{(g)} + C_{(g)}$ ;  
 $(2p_1 + 2p_2) \quad p_1$

$\therefore K_{p1} = 2^2 (p_1 + p_2)^2 \cdot p_1$

$A'_{(s)} \rightleftharpoons 2B_{(g)} + D_{(g)}$   
 $(2p_2 + 2p_1) \quad p_2$

$K_{p2} = 2^2 (p_1 + p_2)^2 \cdot p_2$

$K_{p1}/K_{p2} = p_1/p_2 = 4$

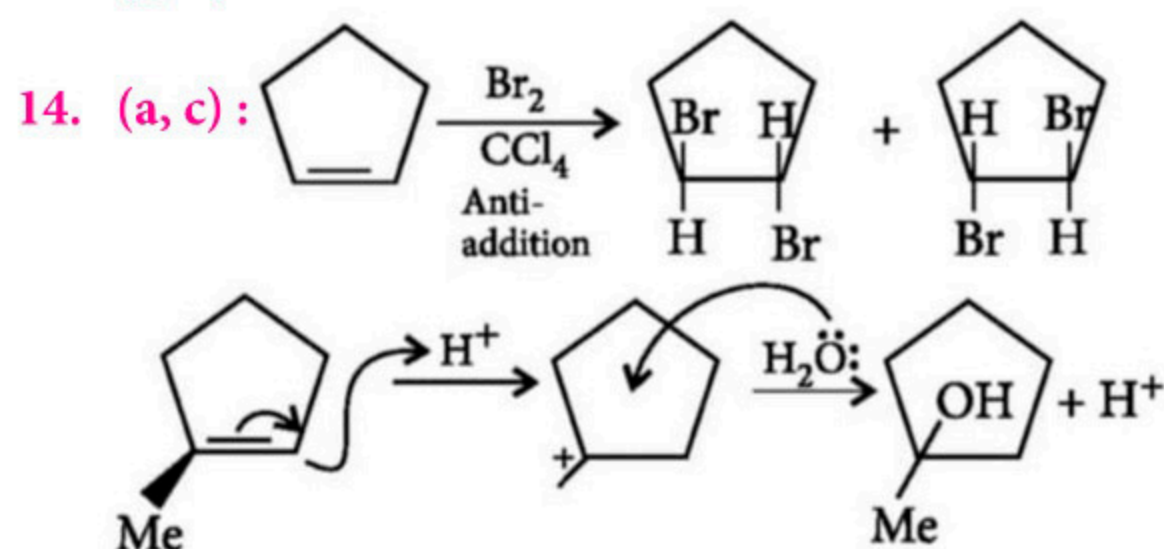
10. (d) :  $[(500 \times 0.2)/1000 + (17.1 \times 3)/342]/0.6 \times 5 = M/12$

11. (c) :  $p_{\text{gas}} = 76 + \frac{40 \times 3.4}{13.6} + \frac{30 \times 6.8}{13.6}$

$= 101 \text{ cm of Hg} = 101/76 \text{ atm}$

12. (a) : Alkenes with odd number of double bonds are planar.

13. (c, d)



15. (b, c, d)





# PRACTICE PAPER

# NEET

Exam on  
3<sup>th</sup> May 2020

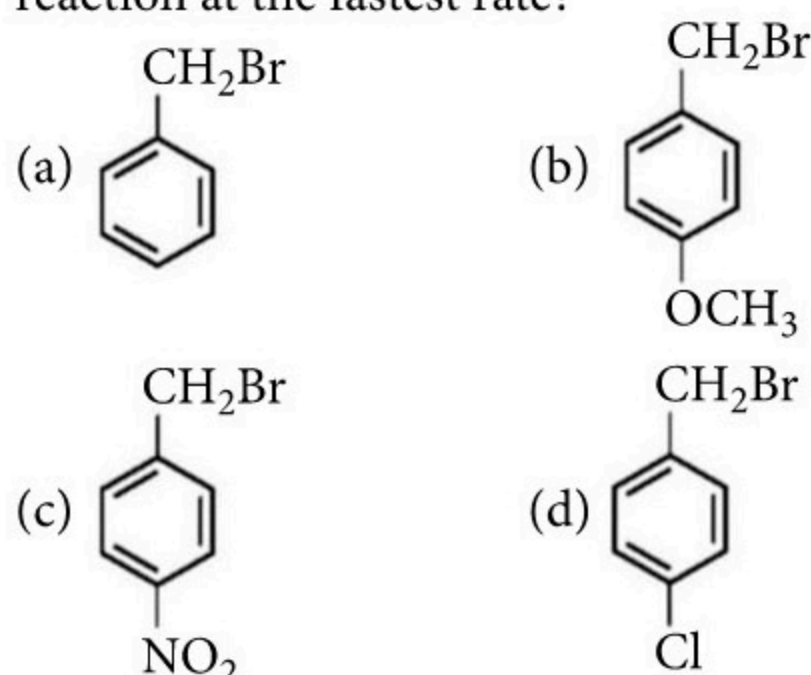
1. In nitroprusside ion the iron and NO exist as  $\text{Fe}^{\text{II}}$  and  $\text{NO}^+$  rather than  $\text{Fe}^{\text{III}}$  and NO. These forms can be differentiated by

(a) estimating the concentration of iron  
(b) measuring the concentration of  $\text{CN}^-$   
(c) measuring the solid state magnetic moment  
(d) thermally decomposing the compound.

2. If the bond energies of H-H, Br-Br, and H-Br are 433, 192 and 364  $\text{kJ mol}^{-1}$  respectively, the  $\Delta H^\circ$  for the reaction,  $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$  is

(a) -261 kJ (b) +103 kJ  
(c) +261 kJ (d) -103 kJ.

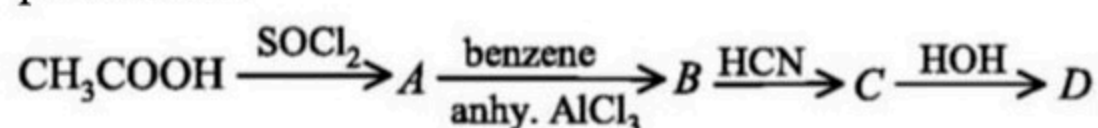
3. Which of the following halides undergoes  $\text{S}_{\text{N}}1$  reaction at the fastest rate?



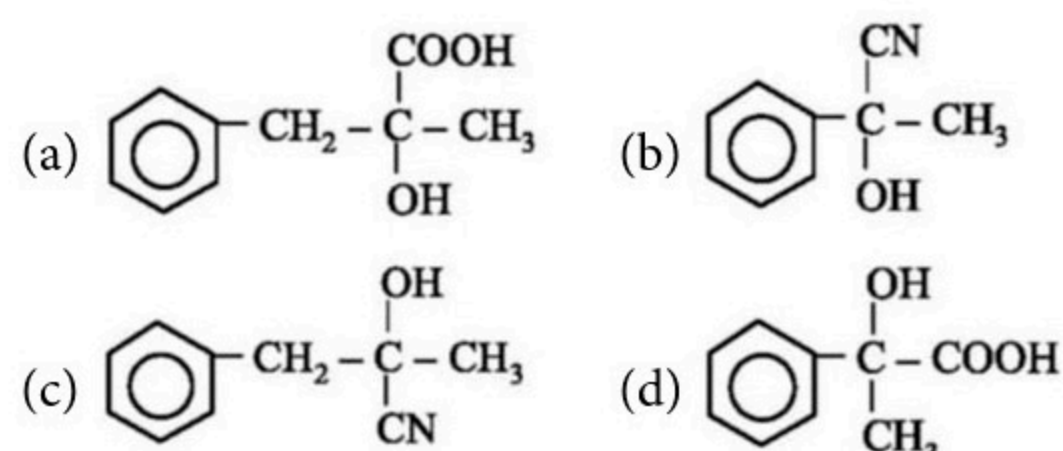
4. A solution of acetone in ethanol  
(a) obeys Raoult's law  
(b) shows a negative deviation from Raoult's law  
(c) shows a positive deviation from Raoult's law  
(d) behaves nearly like an ideal solution.

5. 2 N HCl solution will have same molar conc. as a  
(a) 4.0 N  $\text{H}_2\text{SO}_4$  (b) 0.5 N  $\text{H}_2\text{SO}_4$   
(c) 1 N  $\text{H}_2\text{SO}_4$  (d) 2 N  $\text{H}_2\text{SO}_4$

6. In the following reactions acetic acid yielded a product D.



The structure of D would be



7. Which of the following represents the correct order of their increasing bond order?

(a)  $\text{C}_2^{2-} < \text{He}_2^+ < \text{NO} < \text{O}_2^-$   
(b)  $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2^{2-}$   
(c)  $\text{O}_2^- < \text{NO} < \text{C}_2^{2-} < \text{He}_2^+$   
(d)  $\text{NO} < \text{C}_2^{2-} < \text{O}_2^- < \text{He}_2^+$

8. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of  $\text{Al}_2(\text{SO}_4)_3$ ?

(a)  $2\Lambda_{\text{Al}^{3+}}^\circ + 2\Lambda_{\text{SO}_4^{2-}}^\circ$  (b)  $\Lambda_{\text{Al}^{3+}}^\circ + \Lambda_{\text{SO}_4^{2-}}^\circ$   
(c)  $(\Lambda_{\text{Al}^{3+}}^\circ + \Lambda_{\text{SO}_4^{2-}}^\circ) \times 6$   
(d)  $\frac{1}{3}\Lambda_{\text{Al}^{3+}}^\circ + \frac{1}{2}\Lambda_{\text{SO}_4^{2-}}^\circ$

9.  $\text{H}_2\text{O}$  is dipolar, whereas  $\text{BeF}_2$  is not. It is because

(a) the electronegativity of F is greater than that of O  
(b)  $\text{H}_2\text{O}$  involves hydrogen bonding whereas  $\text{BeF}_2$  is a discrete molecule  
(c)  $\text{H}_2\text{O}$  is linear and  $\text{BeF}_2$  is angular  
(d)  $\text{H}_2\text{O}$  is angular and  $\text{BeF}_2$  is linear.

10. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 u and that of Br = 80 u and Avogadro number being  $6.02 \times 10^{23} \text{ mol}^{-1}$ , the density of CsBr is

(a) 4.25  $\text{g/cm}^3$  (b) 42.5  $\text{g/cm}^3$   
(c) 0.425  $\text{g/cm}^3$  (d) 8.25  $\text{g/cm}^3$ .



11. Ozone is an important constituent of stratosphere because it
- destroys bacteria which are harmful to human life
  - prevents the formation of smog over large cities
  - removes poisonous gases of the atmosphere by reacting with them
  - absorbs ultraviolet radiation which is harmful to human life.
12. Chargaff's rule states that in an organism
- amount of adenine (A) is equal to that of thymine (T) and the amount of guanine (G) is equal to that of cytosine (C)
  - amount of adenine (A) is equal to that of guanine (G) and the amount of thymine (T) is equal to that of cytosine (C)
  - amount of adenine (A) is equal to that of cytosine (C) and the amount of thymine (T) is equal to that of guanine (G)
  - amounts of all bases are equal.
13. The straight chain polymer is formed by
- hydrolysis of  $\text{CH}_3\text{SiCl}_3$  followed by condensation polymerisation
  - hydrolysis of  $(\text{CH}_3)_4\text{Si}$  by addition polymerisation
  - hydrolysis of  $(\text{CH}_3)_2\text{SiCl}_2$  followed by condensation polymerisation
  - hydrolysis of  $(\text{CH}_3)_3\text{SiCl}$  followed by condensation polymerisation.
14. Which among the following is aromatic?
- I

II

III

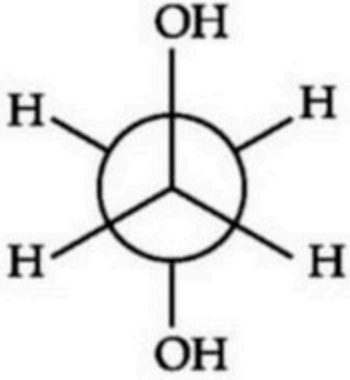
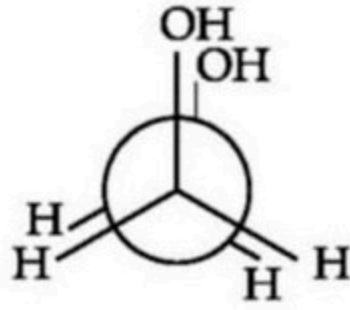
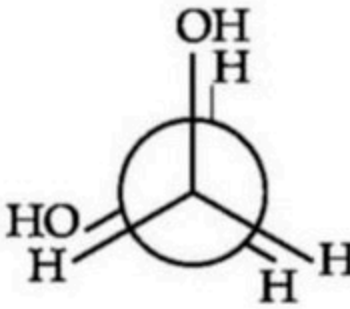
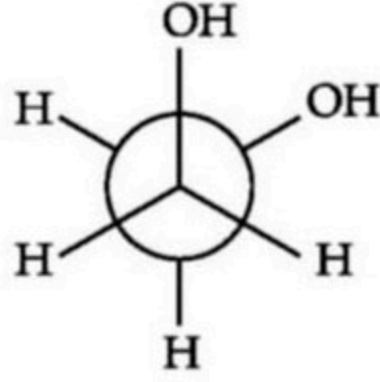
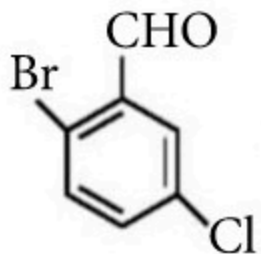
IV

V
- Only I
  - Only II and V
  - Only III and I
  - Only IV
15. Formation of polyethylene from calcium carbide takes place as follows:
- $$\text{CaC}_2 + 2\text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \text{C}_2\text{H}_2$$
- $$\text{C}_2\text{H}_2 + \text{H}_2 \longrightarrow \text{C}_2\text{H}_4$$
- $$n\text{C}_2\text{H}_4 \longrightarrow \text{-(CH}_2\text{-CH}_2\text{)}_n$$
- The amount of polyethylene obtained from 64 kg of  $\text{CaC}_2$  is
- 7 kg
  - 14 kg
  - 21 kg
  - 28 kg
16. Equal masses of  $\text{H}_2$ ,  $\text{O}_2$  and methane have been taken in a container of volume  $V$  at temperature  $27^\circ\text{C}$  in identical conditions. The ratio of the volumes of gases  $\text{H}_2 : \text{O}_2 : \text{methane}$  would be
- 8 : 16 : 1
  - 16 : 8 : 1
  - 16 : 1 : 2
  - 8 : 1 : 2
17. The reaction of aqueous  $\text{KMnO}_4$  with  $\text{H}_2\text{O}_2$  in acidic conditions gives
- $\text{Mn}^{4+}$  and  $\text{O}_2$
  - $\text{Mn}^{2+}$  and  $\text{O}_2$
  - $\text{Mn}^{2+}$  and  $\text{O}_3$
  - $\text{Mn}^{4+}$  and  $\text{MnO}_2$ .
18. Match List I with List II and select the correct answer using the codes gives below the lists :
- | List I                   | List II          |
|--------------------------|------------------|
| A. Iodoform              | I. Anaesthetic   |
| B. Methyl salicylate     | II. Antiseptic   |
| C. Diethyl ether         | III. Insecticide |
| D. Hexachlorocyclohexane | IV. Detergent    |
|                          | V. Pain balm     |
- A-II, B-V, C-III, D-IV
  - A-IV, B-II, C-I, D-III
  - A-II, B-V, C-I, D-III
  - A-III, B-I, C-IV, D-II
19. Ozonolysis of 2, 3-dimethyl-1-butene followed by reduction with zinc and water gives
- methanoic acid and 3-methyl-2-butanone
  - methanal and 2-methyl-2-butanone
  - methanal and 3-methyl-2-butanone
  - methanoic acid and 2-methyl-2-butanone.
20. In a zero-order reaction for every  $10^\circ\text{C}$  rise of temperature, the rate is doubled. If the temperature is increased from  $10^\circ\text{C}$  to  $100^\circ\text{C}$ , the rate of the reaction will become
- 256 times
  - 512 times
  - 64 times
  - 128 times.
21. An ester  $A(\text{C}_9\text{H}_{10}\text{O}_2)$  with excess of  $\text{CH}_3\text{MgBr}$  upon hydrolysis and then with conc.  $\text{H}_2\text{SO}_4$  gives an olefin (B). Ozonolysis of (B) gave a ketone ( $\text{C}_8\text{H}_8\text{O}$ ) which gave positive iodoform test. The structure of A is
- (a)

(b)
- (c)

(d)
22. Which of the following statements is not correct about control of particulate pollution?
- In electrostatic precipitator, the particulates are made to acquire positive charge which are then attracted by the negative electrode and removed.

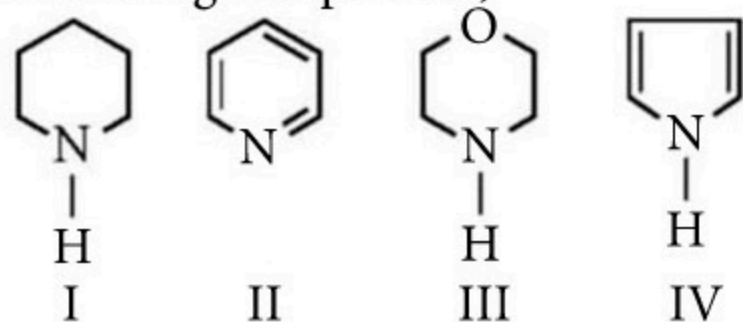


- (b) Gravity settling chamber removes larger particles from the air.  
 (c) Cyclone collector removes fine particles in the diameter range 5-20 microns.  
 (d) Wet scrubbers are used to wash away all types of particulates.
23. The e.m.f. of a Daniell cell at 298 K is  $E_1$
- $$\text{Zn} | \text{ZnSO}_4 (0.01 \text{ M}) || \text{CuSO}_4 (1.0 \text{ M}) | \text{Cu}$$
- when the concentration of  $\text{ZnSO}_4$  is 1.0 M and that of  $\text{CuSO}_4$  is 0.01 M, the e.m.f. changed to  $E_2$ . What is the relationship between  $E_1$  and  $E_2$ ?
- (a)  $E_1 > E_2$  (b)  $E_1 < E_2$   
 (c)  $E_1 = E_2$  (d)  $E_2 = 0 \neq E_1$
24. Which of the following is not permissible arrangement of electrons in an atom?
- (a)  $n = 5, l = 3, m = 0, s = +1/2$   
 (b)  $n = 3, l = 2, m = -3, s = -1/2$   
 (c)  $n = 3, l = 2, m = -2, s = -1/2$   
 (d)  $n = 4, l = 0, m = 0, s = -1/2$
25. The correct order of the mobility of the alkali metal ions in aqueous solution is
- (a)  $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$   
 (b)  $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$   
 (c)  $\text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Li}^+$   
 (d)  $\text{K}^+ > \text{Rb}^+ > \text{Na}^+ > \text{Li}^+$
26. Electronegativity of oxygen is more than sulphur yet  $\text{H}_2\text{S}$  is acidic while water is neutral. This is because
- (a) water is highly associated compound  
 (b) molecular mass of  $\text{H}_2\text{S}$  is more than  $\text{H}_2\text{O}$   
 (c)  $\text{H}_2\text{S}$  is gas while  $\text{H}_2\text{O}$  is a liquid  
 (d) H-S bond is weaker than H-O bond.
27. In a periodic table, the basic character of oxides
- (a) increases from left to right and decreases from top to bottom  
 (b) decreases from right to left and increases from top to bottom  
 (c) decreases from left to right and increases from top to bottom  
 (d) decreases from left to right and increases from bottom to top.
28. Among the following, the pair in which the two species are not isostructural is
- (a)  $\text{SiF}_4$  and  $\text{SF}_4$  (b)  $\text{IO}_3^-$  and  $\text{XeO}_3$   
 (c)  $\text{BH}_4^-$  and  $\text{NH}_4^+$  (d)  $\text{PF}_6^-$  and  $\text{SF}_6$ .
29. If in a pair of immiscible liquids, a common solute dissolves in both and equilibrium is reached, then the concentration of the solute in the upper layer is
- (a) zero  
 (b) in fixed ratio with that in the lower layer  
 (c) lower than that in the lower layer  
 (d) higher than that in the lower layer.
30. Concentrated aqueous sulphuric acid is 98%  $\text{H}_2\text{SO}_4$  by mass and has a density of  $1.80 \text{ g mL}^{-1}$ . Volume of acid required to make one litre of 0.1 M  $\text{H}_2\text{SO}_4$  solution is
- (a) 16.65 mL (b) 22.20 mL  
 (c) 5.55 mL (d) 11.10 mL.
31. Which of the following statements is not correct about Ellingham diagram?
- (a)  $\Delta G$  increases with an increase in temperature.  
 (b) It consists of plots of  $\Delta_f G^\circ$  vs  $T$  for formation of oxides.  
 (c) A coupling reaction can be well expressed by this diagram.  
 (d) It express the kinetics of the reduction process.
32. Which of the following conformers for ethylene glycol is most stable?
- (a)  (b)   
 (c)  (d) 
33.  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$  (at. no. of Cr = 24) has a magnetic moment of 3.83 B.M. The correct distribution of 3d electrons in this chromium complex is
- (a)  $3d_{xy}^1, 3d_{yz}^1, 3d_{z^2}^1$   
 (b)  $3d_{(x^2-y^2)}^1, 3d_{z^2}^1, 3d_{xz}^1$   
 (c)  $3d_{xy}^1, 3d_{(x^2-y^2)}^1, 3d_{yz}^1$   
 (d)  $3d_{xy}^1, 3d_{yz}^1, 3d_{xz}^1$
34. The correct IUPAC name of the given compound
-  is



- (a) *o*-bromo-*p*-chlorobenzaldehyde  
 (b) 2-bromo-5-chlorobenzaldehyde  
 (c) 6-bromo-3-chlorobenzaldehyde  
 (d) 1-bromo-4-chlorobenzaldehyde.

35. In the following compounds,



the order of basicity is

- (a) IV > I > III > II (b) III > I > IV > II  
 (c) II > I > III > IV (d) I > III > II > IV
36. The temperature dependence of rate constant ( $k$ ) of a chemical reaction is written in terms of Arrhenius equation,  $k = A \cdot e^{-E_a/RT}$ . Activation energy ( $E_a$ ) of the reaction can be calculated by plotting

- (a)  $k$  vs  $T$  (b)  $k$  vs  $\frac{1}{\log T}$   
 (c)  $\log k$  vs  $\frac{1}{T}$  (d)  $\log k$  vs  $\frac{1}{\log T}$

37. A compound is soluble in conc.  $H_2SO_4$ . It does not decolourise bromine in carbon tetrachloride but is oxidised by chromic anhydride in aqueous sulphuric acid within two seconds, turning orange solution to blue, green and then opaque. The original compound is  
 (a) a primary alcohol (b) a tertiary alcohol  
 (c) an alkane (d) an ether.

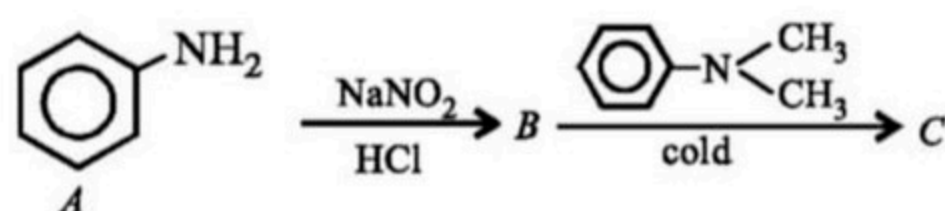
38. Which of the following structures is similar to graphite?

- (a)  $B_4C$  (b)  $B_2H_6$  (c) BN (d) B

39. Among the following which is not the  $\pi$ -bonded organometallic compound?

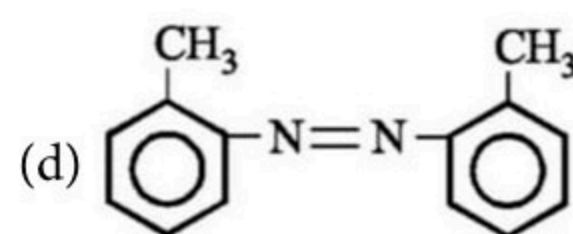
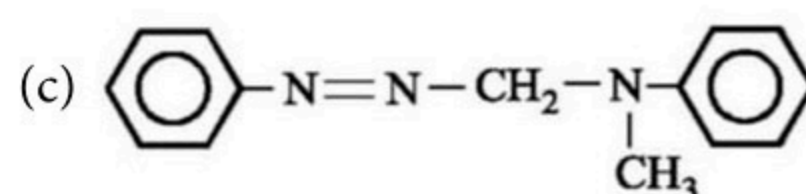
- (a)  $K[PtCl_3(\eta^2-C_2H_4)]$   
 (b)  $Fe(\eta^5-C_5H_5)_2$   
 (c)  $Cr(\eta^6-C_6H_6)_2$  (d)  $(CH_3)_4Sn$

40. In a reaction of aniline, a coloured product C was obtained.



The structure of C would be

- (a) (b)



41. The rapid change of pH near the stoichiometric point of an acid-base titration is the basis of indicator detection. pH of the solution is related to ratio of the concentrations of the conjugate acid (HIn) and base ( $In^-$ ) forms of the indicator by the expression

- (a)  $\log \frac{[In^-]}{[HIn]} = pK_{In} - pH$   
 (b)  $\log \frac{[HIn]}{[In^-]} = pK_{In} - pH$   
 (c)  $\log \frac{[HIn]}{[In^-]} = pH - pK_{In}$   
 (d)  $\log \frac{[In^-]}{[HIn]} = pH - pK_{In}$

42. For vaporization of water at 1 atmospheric pressure, the values of  $\Delta H$  and  $\Delta S$  are  $40.63 \text{ kJ mol}^{-1}$  and  $108.8 \text{ JK}^{-1} \text{ mol}^{-1}$ , respectively. The temperature when Gibbs' energy change ( $\Delta G$ ) for this transformation will be zero, is

- (a) 273.4 K (b) 393.4 K  
 (c) 373.4 K (d) 293.4 K

43. The ions  $O^{2-}$ ,  $F^-$ ,  $Na^+$ ,  $Mg^{2+}$  and  $Al^{3+}$  are isoelectronic. Their ionic radii show

- (a) a significant increase from  $O^{2-}$  to  $Al^{3+}$   
 (b) a significant decrease from  $O^{2-}$  to  $Al^{3+}$   
 (c) an increase from  $O^{2-}$  to  $F^-$  and then decrease from  $Na^+$  to  $Al^{3+}$   
 (d) a decrease from  $O^{2-}$  to  $F^-$  and then increase from  $Na^+$  to  $Al^{3+}$ .

44. The increasing oxidation states of sulphur in the anions  $SO_3^{2-}$ ,  $S_2O_4^{2-}$  and  $S_2O_6^{2-}$  follow the order

- (a)  $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$   
 (b)  $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$   
 (c)  $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$   
 (d)  $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

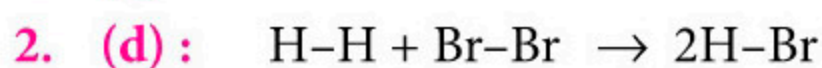
45. A 0.1 molal solution of a weak acid is 45% ionized. Calculate depression in freezing point. (Molecular weight of the acid is 300,  $K_f = 1.86 \text{ K mol}^{-1} \text{ kg.}$ )

- (a)  $-0.199^\circ\text{C}$  (b)  $2.00^\circ\text{C}$   
 (c)  $0^\circ\text{C}$  (d)  $-0.269^\circ\text{C}$



## SOLUTIONS

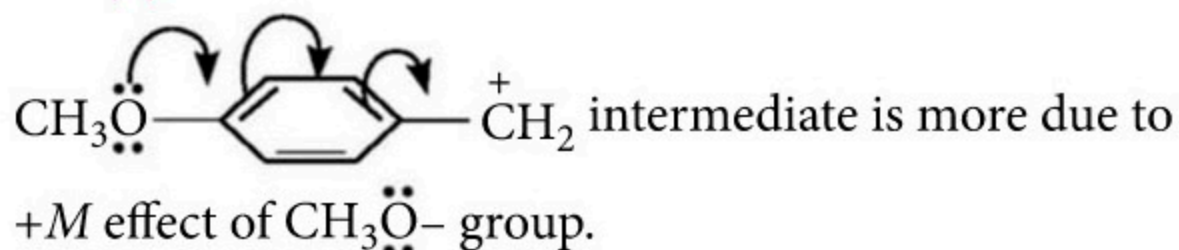
1. (c)



Bond Energy    433        192         $2 \times 364$   
(kJ mol<sup>-1</sup>)

$$\begin{aligned}\text{Net energy released} &= \Sigma H_R - \Sigma H_P \\ &= (433 + 192) - 2 \times 364 \\ &= 625 - 728 = -103 \text{ kJ}\end{aligned}$$

3. (b): Resonance stabilisation of



4. (c): Both the components escape easily showing higher vapour pressure than the expected value.

5. (a): From the relation

$$\frac{\text{Normality}}{\text{Molarity}} = \frac{\text{Molecular mass}}{\text{Equivalent mass}} = n$$

For 2 N HCl,

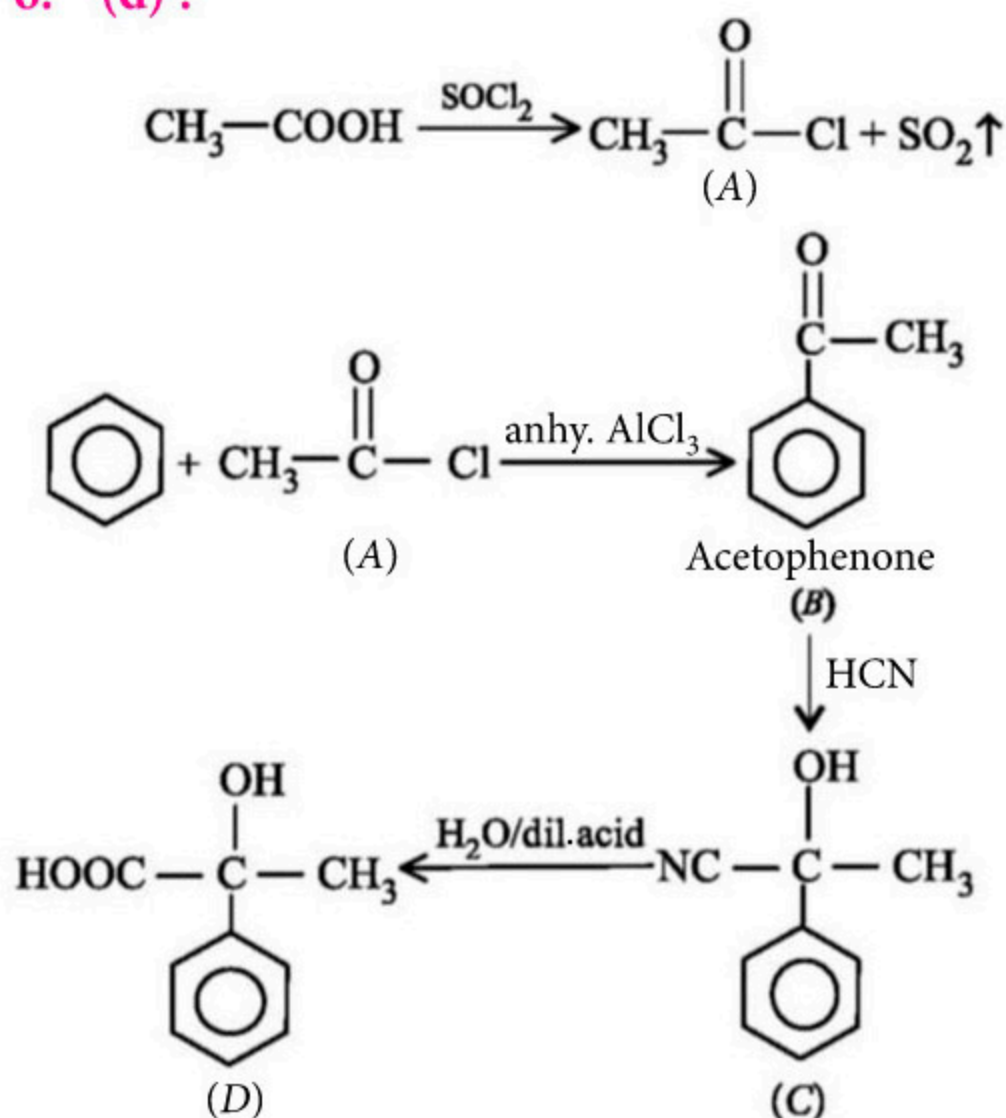
$$\text{Molarity} = \frac{\text{Normality} \times \text{Equivalent weight}}{\text{Molecular weight}}$$

$$\text{Molarity} = \frac{2 \times 36.5}{36.5} = 2$$

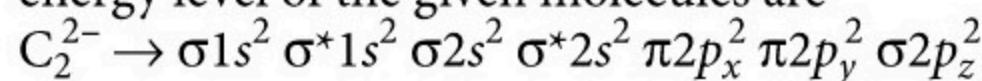
For 4 N H<sub>2</sub>SO<sub>4</sub>,  $\text{Molarity} = \frac{4 \times 49}{98} = 2$

Hence, 4 N H<sub>2</sub>SO<sub>4</sub> and 2 N HCl solution will have same molar concentration.

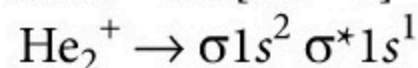
6. (d):



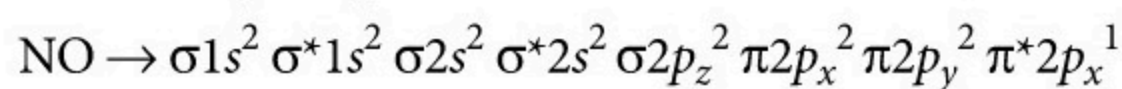
7. (b): According to molecular orbital theory, the energy level of the given molecules are



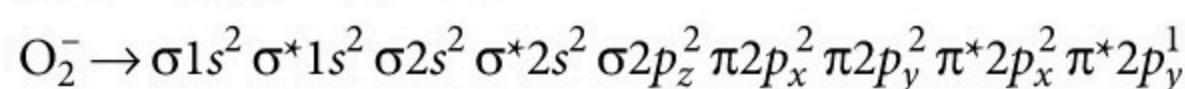
$$\text{B.O.} = 1/2[10 - 4] = 3$$



$$\text{B.O.} = 1/2[2 - 1] = 1/2 = 0.5$$



$$\text{B.O.} = 1/2[10 - 5] = 2.5$$



$$\text{B.O.} = 1/2[10 - 7] = 1.5$$

So, the correct order of their increasing bond order is  $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2^{2-}$

8. (b)

9. (d)

$$\begin{aligned}10. (a): \text{Density of CsBr} &= \frac{Z \times M}{V \times N_A} \\ &= \frac{1 \times 213}{(436.6 \times 10^{-10})^3 \times 6.023 \times 10^{23}} = 4.25 \text{ g/cm}^3\end{aligned}$$

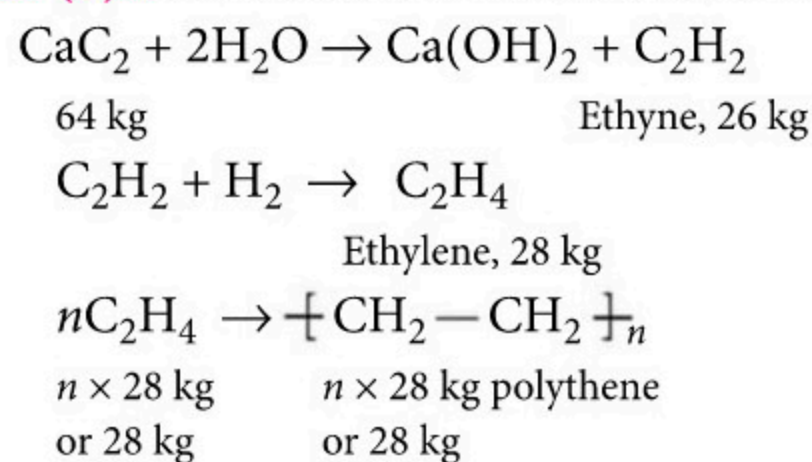
11. (d): Ozone absorbs U.V. radiations harmful to human life.

12. (a)

13. (c)

14. (a): Only structure I has  $8 + 2 = 10$   $\pi$  electrons, hence it is aromatic; II has 4, III has 8, IV has 9 and V has 4 electrons hence, are not aromatic.

15. (d): The concerned chemical reactions are

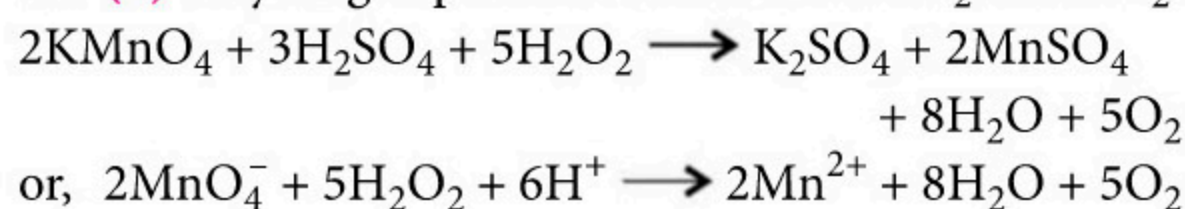


$$16. (c): \text{No. of moles} = \frac{\text{Mass}}{\text{Mol. mass}}$$

$$n_{\text{H}_2} = \frac{w}{2}; n_{\text{O}_2} = \frac{w}{32}; n_{\text{CH}_4} = \frac{w}{16}$$

$$\text{So, the ratio is } \frac{w}{2} : \frac{w}{32} : \frac{w}{16} \text{ or } 16:1:2$$

17. (b): Hydrogen peroxide is oxidised to H<sub>2</sub>O and O<sub>2</sub>.



18. (c)







# CHEMISTRY MUSING

## SOLUTION SET 78

$$1. (d): K_p = \frac{P_{SO_3}^2}{P_{SO_2}^2 \cdot P_{O_2}} = \frac{(x_{SO_3} P)^2}{(x_{SO_2} P)^2 (x_{O_2} P)} = \frac{(x_{SO_3})^2}{(x_{SO_2})^2 (x_{O_2} P)}$$

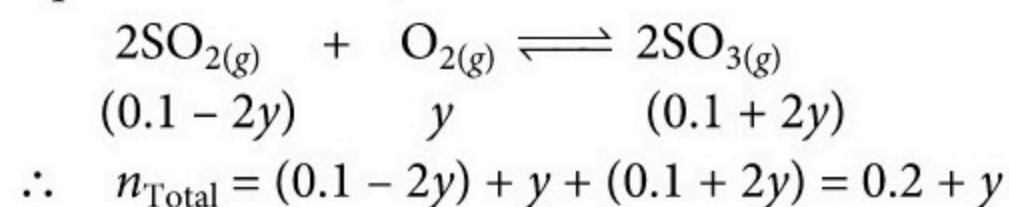
where,  $x$  is mole fraction and  $P$  is the total pressure.

$$\therefore K_p = \frac{(n_{SO_3})^2 n_{Total}}{(n_{SO_2})^2 n_{O_2}} \times \frac{1}{P} \quad \left( \because x = \frac{n}{n_{Total}} \right)$$

Since, for an ideal gas mixture,  $PV = n_{Total} RT$ ,

$$\therefore K_p = \frac{(n_{SO_3})^2}{(n_{SO_2})^2 n_{O_2}} \times \left( \frac{V}{RT} \right) \quad \dots(i)$$

Let  $y$  be the number of moles of  $O_2$  reacted at equilibrium. Then,



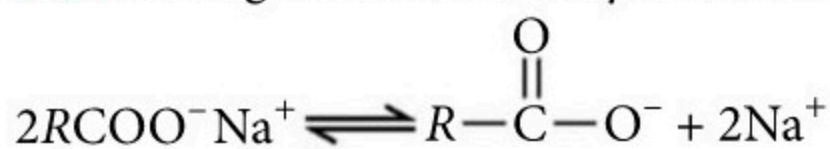
$$\text{Also, } n_{Total} = \frac{PV}{RT} = \frac{(2.78 \text{ atm})(2 \text{ dm}^3)}{(0.08206 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1})(300 \text{ K})} = 0.226 \text{ mole}$$

Thus,  $0.226 = 0.2 + y \Rightarrow y = 0.026 \text{ mole}$

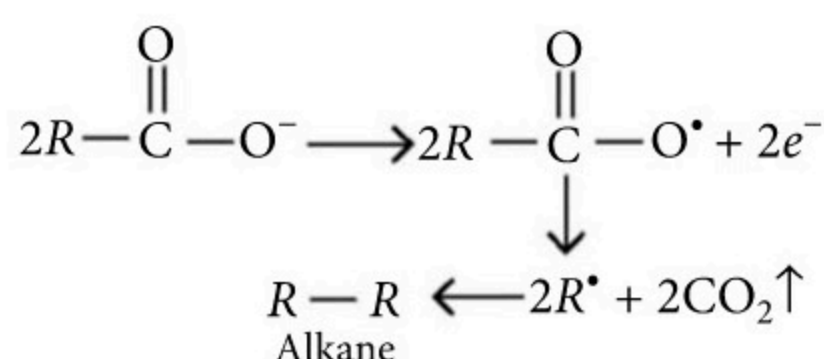
Substituting the value of  $y$  in eq. (i), we have

$$K_p = \frac{(0.1 + 2y)^2}{(0.1 - 2y)^2 y} \left( \frac{V}{RT} \right) = \frac{(0.152 \text{ mol})^2 (2 \text{ dm}^3)}{[(0.048 \text{ mol})^2 (0.026 \text{ mol})(0.08206 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1})(300 \text{ K})]} = 31.33 \text{ atm}^{-1}$$

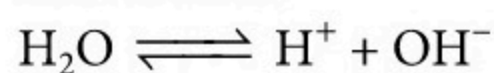
2. (b): During Kolbe's electrolysis reactions,



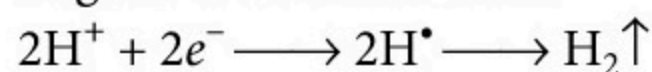
At anode :



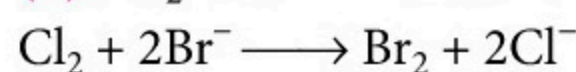
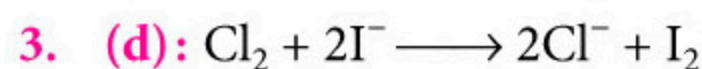
At cathode :



Reduction potential of  $H^+ > Na^+$ . So  $H^+$  from  $H_2O$  migrate towards cathode.



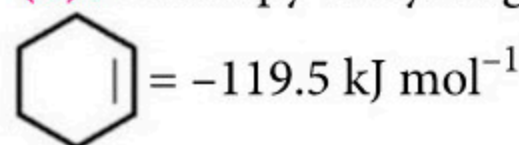
NaOH is formed as side product. So, during reaction, pH of medium increases.



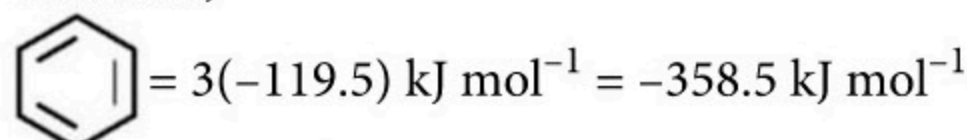
Oxidizing power :  $Cl_2 > Br_2 > I_2$

Hence,  $Cl_2$  oxidises  $I^-$  first to  $I_2$  which gives violet colour in  $CCl_4$ , then  $Br^-$  to  $Br_2$ , which gives brown colour in  $CCl_4$ , finally  $I_2$  is oxidised to  $IO^-$ . Hence, the  $CCl_4$  layer turns colourless.

4. (d): Enthalpy of hydrogenation of cyclohexene ;



$\therefore$  Calculate enthalpy of hydrogenation of benzene ;



As actual value is lower by amount equal to resonance energy, therefore actual enthalpy of hydrogenation

$$= -358.5 \text{ kJ mol}^{-1} - (-150.4 \text{ kJ mol}^{-1}) = -208.1 \text{ kJ mol}^{-1}$$

5. (a): Specific conductance,  $\kappa = \text{cell constant}/R$ ,

$$\therefore \text{cell constant} = \kappa R = (0.277 \text{ S m}^{-1})(250 \Omega) = 69.2 \text{ m}^{-1} \quad (\because S = \Omega^{-1})$$

For  $NH_4OH$  solution,  $c = 6 \times 10^{-5} \text{ M}$

$$= 6 \times 10^{-5} \text{ mol dm}^{-3} = 6 \times 10^{-2} \text{ mol m}^{-3}$$

$$\Lambda_m = \frac{\kappa}{C} = \frac{\text{cell constant}}{CR} = \frac{69.2 \text{ m}^{-1}}{(6 \times 10^{-2} \text{ mol m}^{-3})(10^5 \Omega)} = 115 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

According to Kohlrausch's law,

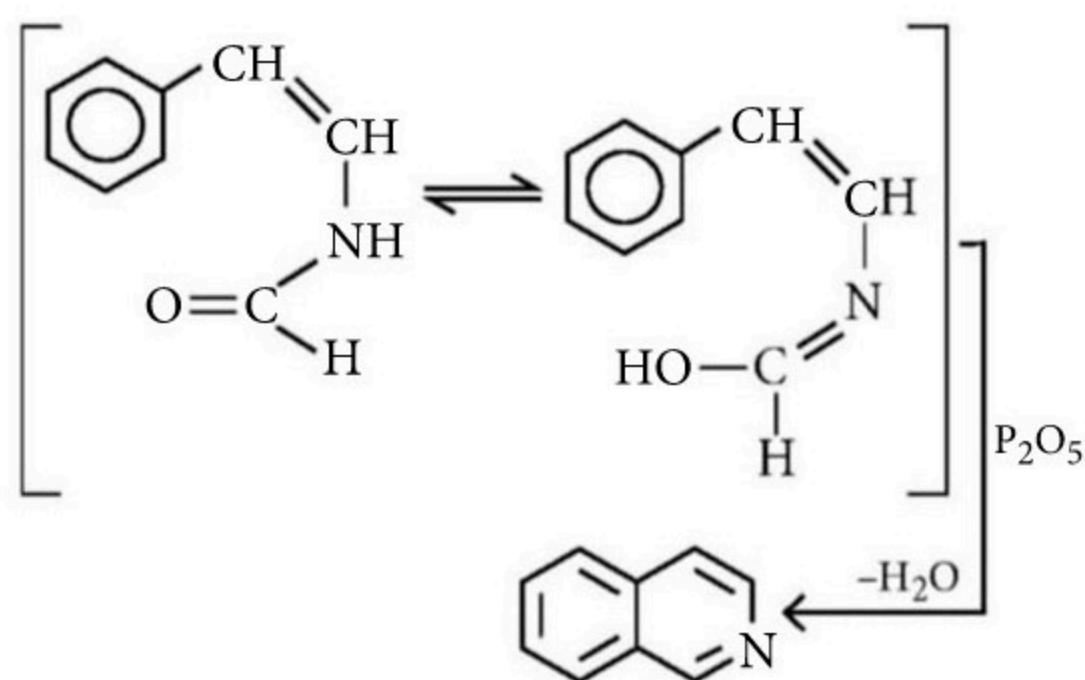
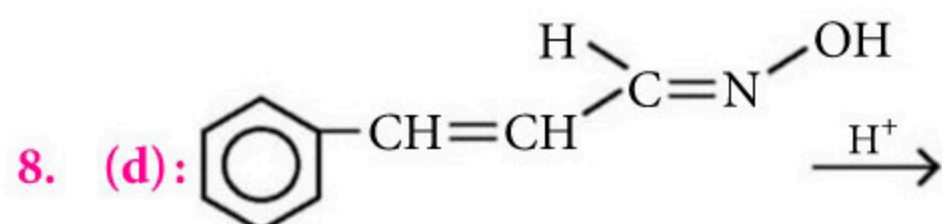
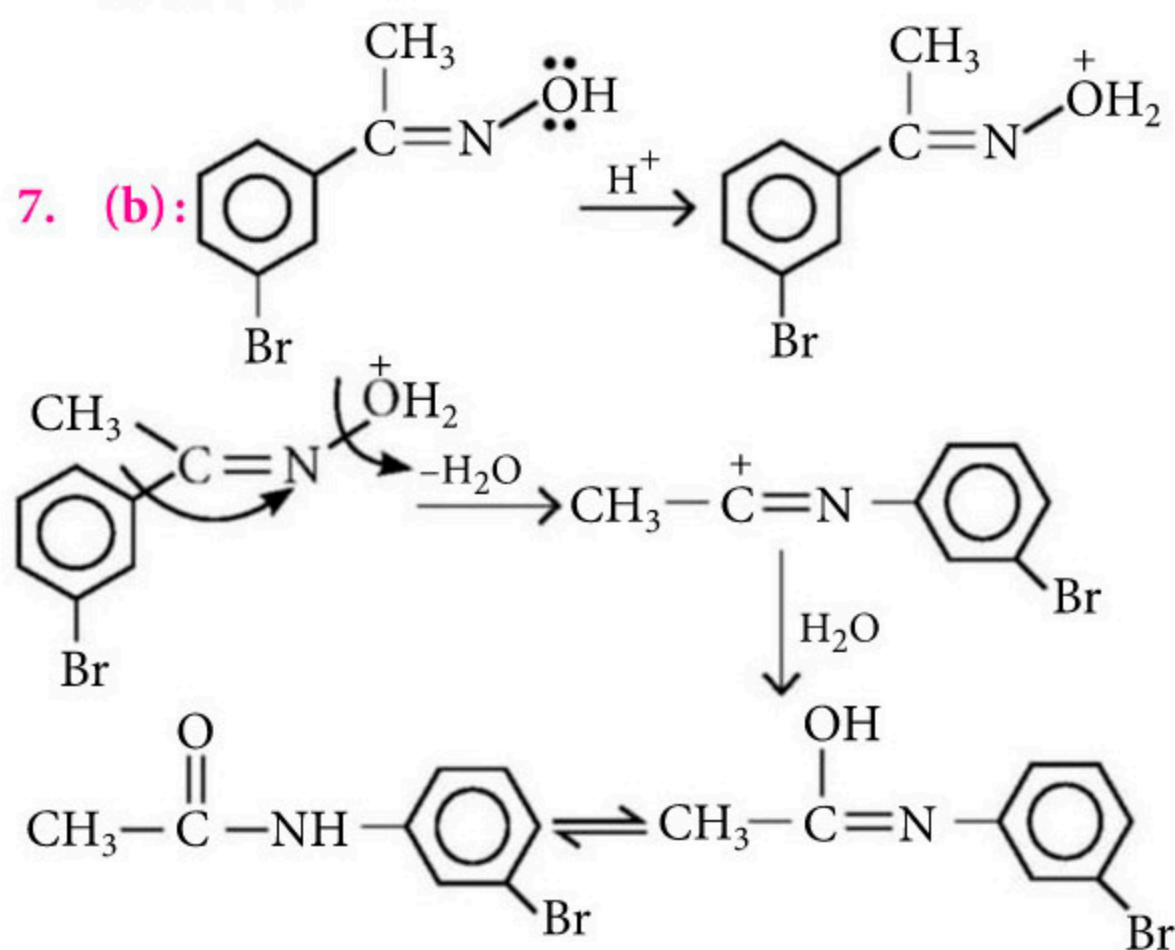
$$\Lambda_m^\circ = \lambda_+^\circ + \lambda_-^\circ = (73.4 + 198.0) \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1} = 271.4 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{115 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}}{271.4 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}} = 0.424$$

6. (b, c, d): In  $d$ -block elements, group 6, Mo (VI) and W(VI) are found to be more stable than Cr (VI). Copper (I) compounds are unstable in aqueous solution and undergo disproportionation.



$E^\circ$  of  $\text{Zn}^{2+}/\text{Zn}$  is more negative than expected due to the removal of an electron from the stable  $d^{10}$  configuration of  $\text{Zn}^{2+}$ . The  $E^\circ$  values for the redox couple  $M^{3+}/M$  indicates that  $\text{Mn}^{3+}$  and  $\text{Co}^{3+}$  ions are the strongest oxidizing agents in aqueous solutions.



9. (0.13) : Let  $a$  g of sample is weighed out for the analysis.

$$\text{Wt. of NaCl} = \frac{60}{100} \times a = 0.6a \text{ g}$$

$$\text{Wt. of KCl} = \frac{37}{100} \times a = 0.37a \text{ g}$$

Now this mixture reacts with  $\text{AgNO}_3$ , the excess of  $\text{AgNO}_3$  is back titrated with  $\text{NH}_4\text{SCN}$ .

$$\text{Meq. of AgNO}_3 \text{ added to mixture} = 25 \times 0.1 = 2.5$$

Normality of  $\text{NH}_4\text{SCN}$  can be derived as :

$$\text{Meq. of NH}_4\text{SCN} = \text{Meq. of AgNO}_3$$

$$N \times 1 = 0.1 \times 1.1$$

$$N = 0.11$$

$$\text{Meq. of AgNO}_3 \text{ left} = \text{Meq. of NH}_4\text{SCN} = 5 \times N$$

$$\text{Meq. of AgNO}_3 \text{ left} = 5 \times 0.11 = 0.55$$

$$\text{Meq. of AgNO}_3 \text{ used for mixture} = 2.5 - 0.55 = 1.95$$

$$\text{Meq. of KCl} + \text{Meq. of NaCl in mixture} = 1.95$$

$$\frac{0.37a}{74.5} \times 1000 + \frac{0.6a}{58.5} \times 1000 = 1.95$$

$$a = 0.128 \text{ g}$$

10. (421.9) : Case I, at 300 K :

Let pressure in upper part be  $P_1$  and in lower part be  $P_2$ . Also  $P_0$  is pressure of piston.

$$\text{At equilibrium, } P_2 = P_0 + P_1 \quad \dots(i)$$

Let volume of cylinder be  $V$  litre

$$\text{Volume of upper part} = \frac{4V}{5}$$

$$\text{and, volume of lower part} = \frac{V}{5}$$

Also in the two parts of cylinder, each part contains 1 mole at 300 K and thus,

$$P_1 \times \frac{4V}{5} = P_2 \times \frac{V}{5}$$

$$\therefore \frac{P_2}{P_1} = 4 \quad \dots(ii)$$

$$\text{By eqn (i) and (ii), } P_1 = \frac{P_0}{3} \quad \dots(iii)$$

Case II, at  $T$  K :

Now the temperature becomes  $T$  at which volume of upper part is  $\frac{3V}{4}$  and lower part is  $\frac{V}{4}$ .

$$\text{Again, } P'_1 \times \frac{3V}{4} = P'_2 \times \frac{V}{4}$$

$$\therefore \frac{P'_2}{P'_1} = 3 \quad \dots(iv)$$

$$\text{By eqns (i) and (iv), } P'_1 = \frac{P_0}{2} \quad \dots(v)$$

Now using,  $PV = nRT$  for upper parts of cylinder at 300 K and  $T$  K.

$$P_1 \times \frac{4V}{5} = 1 \times R \times 300 \quad ; \text{ Case I upper part}$$

$$P'_1 \times \frac{3V}{4} = 1 \times R \times T \quad ; \text{ Case II upper part}$$

$$\therefore \frac{P_1}{P'_1} \times \frac{16}{15} = \frac{300}{T} \quad \dots(vi)$$

$$\text{Using eqns. (iii) and (v) in eqn (vi), } \frac{2}{3} \times \frac{16}{15} = \frac{300}{T}$$

$$T = \frac{300 \times 3 \times 15}{2 \times 16} = 421.875 \text{ K}$$





# GET SET GO JEE

for

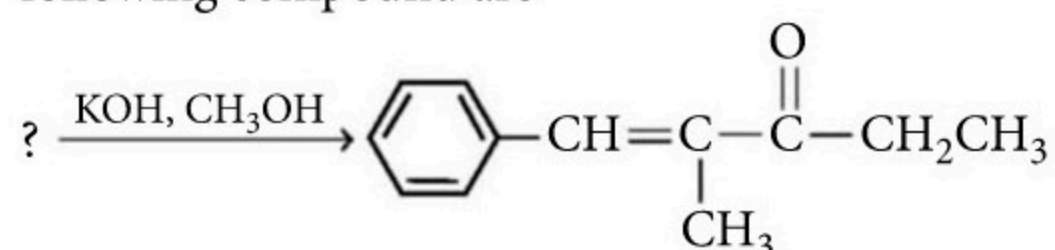


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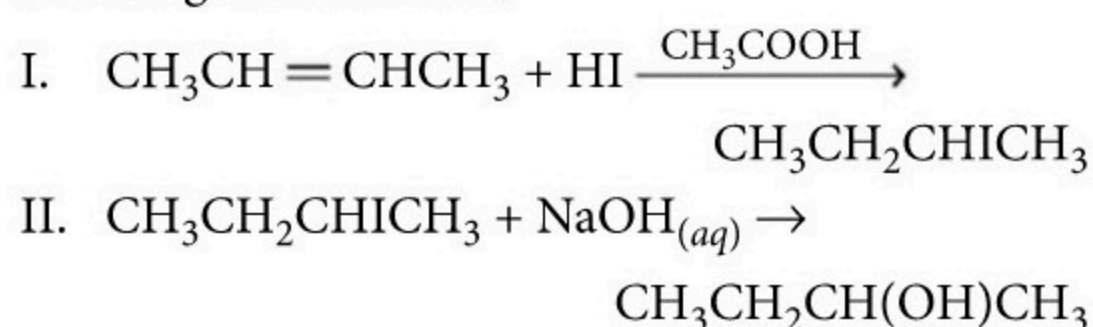
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## Only One Option Correct Type

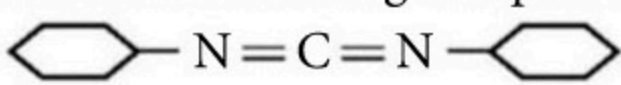
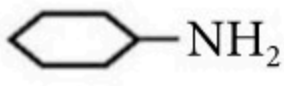
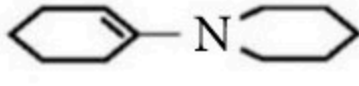
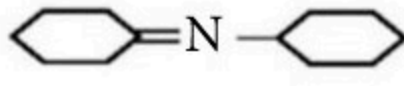
1. The starting compounds needed to produce the following compound are



- (a) benzaldehyde and 3-pentanone  
(b) acetophenone and 2-butanone  
(c) acetophenone and butanal  
(d) benzaldehyde and 2-pentanone.
2. The dispersed phase, dispersion medium and the nature of colloidal solution of gold sol respectively are  
(a) solid, solid and lyophobic  
(b) liquid, liquid and lyophobic  
(c) solid, liquid and lyophobic  
(d) solid, liquid and lyophilic.
3. For the given reactions,



Type of reactions I and II respectively are

- (a) electrophilic addition and electrophilic substitution reaction  
(b) electrophilic addition and nucleophilic substitution reaction  
(c) nucleophilic addition and electrophilic substitution reaction  
(d) nucleophilic addition and free radical substitution reaction.
4. In the metal carbonyls of general formula  $M(\text{CO})_x$  (which follows Effective Atomic Number (EAN) rule) if  $M$  is Ni, Fe and Cr the value of  $x$  will be respectively  
(a) 6, 5, 6 (b) 4, 5, 6 (c) 4, 4, 5 (d) 4, 6, 6
5.  $\text{KMnO}_4$  is a strong oxidizing agent in acidic medium. To provide acidic medium,  $\text{H}_2\text{SO}_4$  is used instead of  $\text{HCl}$ . This is because  
(a)  $\text{H}_2\text{SO}_4$  is a stronger acid than  $\text{HCl}$   
(b)  $\text{HCl}$  is oxidised by  $\text{KMnO}_4$  to  $\text{Cl}_2$   
(c)  $\text{H}_2\text{SO}_4$  is a dibasic acid  
(d) rate is faster in the presence of  $\text{H}_2\text{SO}_4$ .
6. Which of the following compounds is an enamine?  
(a)   
(b)   
(c)   
(d) 

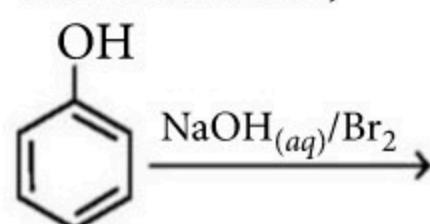


7. If extent of dissociation of both KCl and BaCl<sub>2</sub> of same concentrations with identical value of  $\alpha$  is 0.95, what is the ratio of their van't Hoff factors?  
 (a) 1.95 : 2.9 (b) 1.89 : 1  
 (c) 1 : 2.21 (d) 2.11 : 1
8. Anode mud obtained after electrolytic refining of copper contains  
 (a) Ag (b) Au  
 (c) Pt (d) all of these.
9. Polyvinyl alcohol can be prepared by  
 (a) polymerisation of vinyl alcohol  
 (b) alkaline hydrolysis of polyvinyl acetate  
 (c) polymerisation of acetylene  
 (d) reaction of acetylene with H<sub>2</sub>SO<sub>4</sub> in presence of HgSO<sub>4</sub>.
10. The non-stoichiometric iron oxide has a composition Fe<sub>0.94</sub>O. What would be the ratio of ferrous and ferric ions present in it?  
 (a) 32 : 5 (b) 41 : 6 (c) 37 : 4 (d) 43 : 5

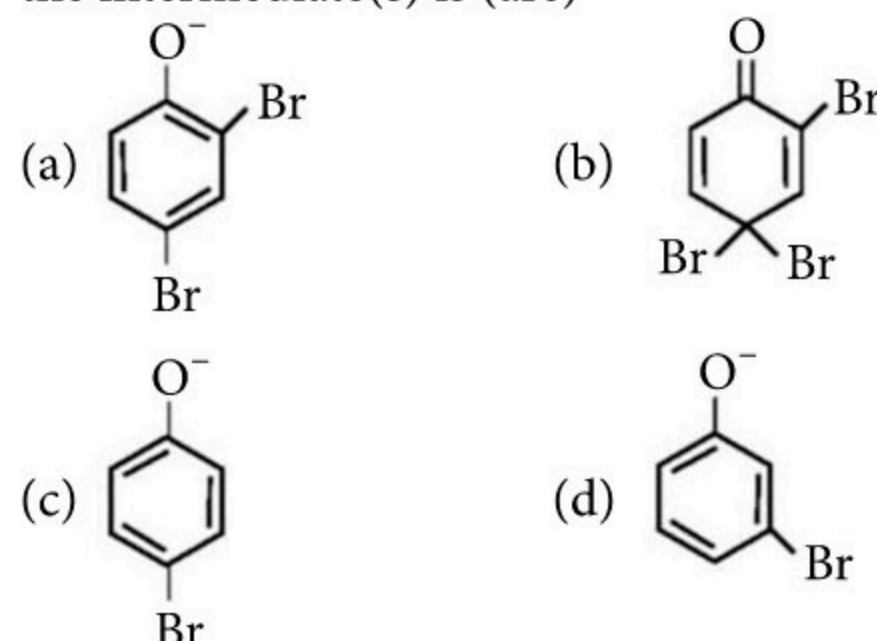
### More Than One Options Correct Type

11. For the reduction of NO<sub>3</sub><sup>-</sup> ion in an aqueous solution, E° is +0.96 V. Values of E° for some metal ions are given below :  
 $V_{(aq)}^{2+} + 2e^- \rightarrow V$  ; E° = -1.19 V  
 $Fe_{(aq)}^{3+} + 3e^- \rightarrow Fe$  ; E° = -0.04 V  
 $Au_{(aq)}^{3+} + 3e^- \rightarrow Au$  ; E° = +1.40 V  
 $Hg_{(aq)}^{2+} + 2e^- \rightarrow Hg$  ; E° = +0.86 V  
 The pair(s) of metals that is(are) oxidised by NO<sub>3</sub><sup>-</sup> in aqueous solution is(are)  
 (a) V and Hg (b) Hg and Fe  
 (c) Fe and Au (d) Fe and V.
12. Consider the oxoacids of HClO<sub>n</sub> series, here value of n is 1 to 4. Then correct statements regarding these oxo acids are  
 (a) acidic character of oxoacids increases with increasing value of n.  
 (b) oxidising power of oxoacids increases with decreasing value of n.  
 (c) thermal stability of oxoacids decreases with increasing value of n.  
 (d) Cl—O bond order decreases with decreasing value of n.

13. In the reaction,



the intermediate(s) is (are)



14. The correct statements among the following are  
 (a) effective collisions are more if activation energy is less.  
 (b) zero order reaction proceeds at a constant rate independent of concentration or time.  
 (c) reactions with highest rate constant value have lowest activation energies.  
 (d) if initial concentration increases half-life decreases in zero order.
15. Which of the following statements are correct about peptide bond?  
 (a) C—N bond length in proteins is longer than usual C—N bond length.  
 (b) Spectroscopic analysis shows planar structure of  $\begin{array}{c} \text{O} \\ \parallel \\ \text{—C—NH—} \end{array}$  bond.  
 (c) C—N bond length in proteins is smaller than usual C—N bond length.  
 (d) Three peptide linkages form tripeptide.





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## HIGHLIGHTS

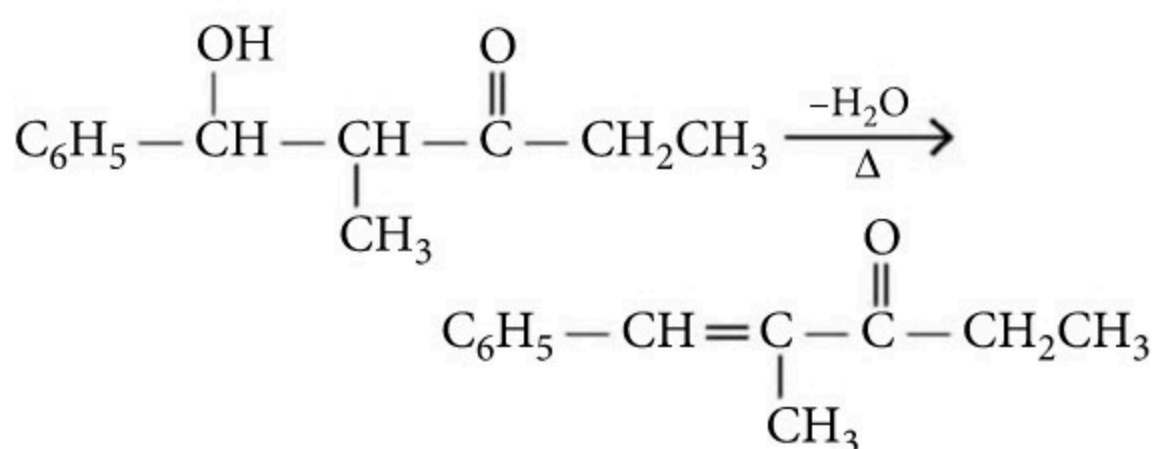
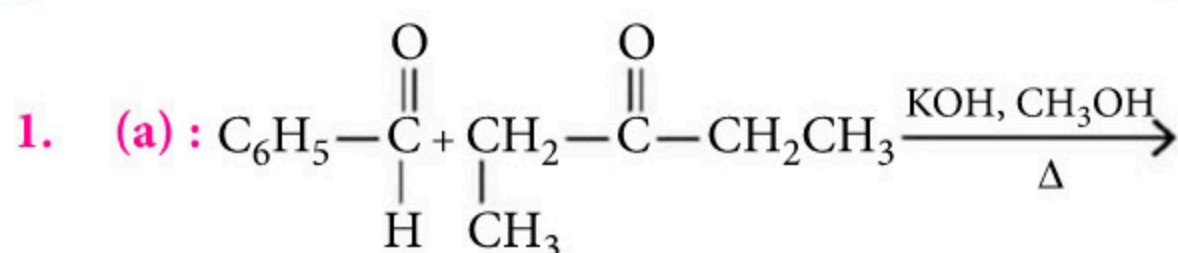
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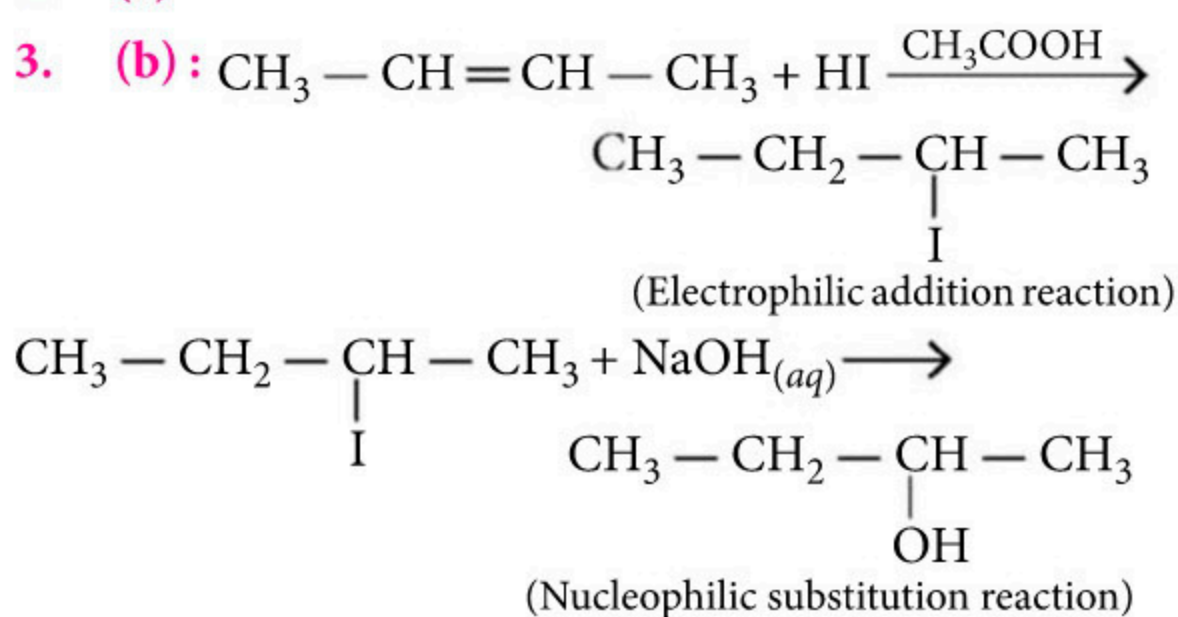
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## SOLUTIONS



2. (c)



4. (b):  $M(\text{CO})_x$  follows EAN rule.

EAN = Atomic no. of metal - oxidation state of metal +  
 $2 \times$  coordination no. (C.N.) of metal

or 
$$\text{C.N.} = \frac{\text{EAN} - \text{At. No.} + \text{O.S.}}{2}$$

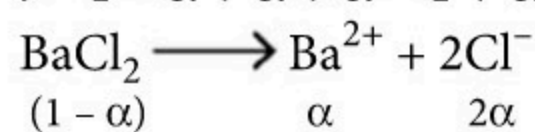
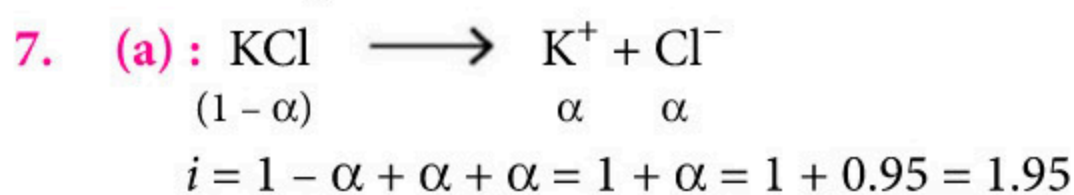
$$\text{C.N. of Ni} = \frac{36 - 28 + 0}{2} = 4$$

$$\text{C.N. of Fe} = \frac{36 - 26 + 0}{2} = 5$$

$$\text{C.N. of Cr} = \frac{36 - 24 + 0}{2} = 6$$

5. (b):  $\text{KMnO}_4$  oxidises  $\text{HCl}$  to  $\text{Cl}_2$ .

6. (c): Enamines are unsaturated compounds derived by the coordination of an aldehyde or ketone with secondary amines.



$$i = 1 - \alpha + \alpha + 2\alpha = 1 + 2\alpha = 1 + 2(0.95) = 2.9$$

The ratio of van't Hoff factors for  $\text{KCl}$  and  $\text{BaCl}_2$  is  $1.95 : 2.9$

8. (d)

9. (b): Vinyl alcohol ( $\text{CH}_2=\text{CH}-\text{OH}$ ) is less thermodynamically stable with respect to its tautomer acetaldehyde ( $\text{CH}_3\text{CHO}$ ). Hence, polyvinyl alcohol is best prepared by the alkaline hydrolysis of polyvinyl acetate which in turn is prepared by the polymerisation of vinyl acetate.

10. (b): In  $\text{Fe}_{0.94}\text{O}$ , some of the  $\text{Fe}^{2+}$  ions are replaced by  $\text{Fe}^{3+}$  ions.

Let number of  $\text{Fe}^{2+}$  ions =  $x$

then number of  $\text{Fe}^{3+}$  ions =  $(0.94 - x)$

Total positive charge must be balanced by total negative charge,  $2x + 3(0.94 - x) = 2$

$$2x + 2.82 - 3x = 2 \Rightarrow x = 0.82$$

So,  $\text{Fe}^{2+} = 0.82$

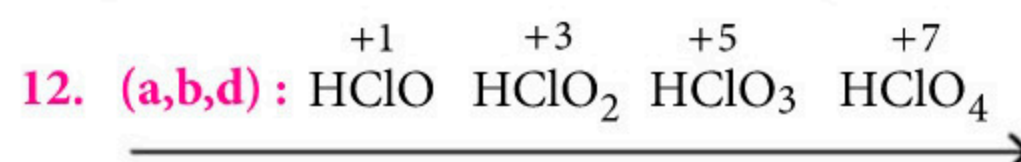
$$\therefore \text{Fe}^{3+} = (0.94 - 0.82) = 0.12$$

Ratio of  $\text{Fe}^{2+}$  (ferrous ions) to  $\text{Fe}^{3+}$  (ferric ions):

$$\frac{\text{Fe}^{2+}}{\text{Fe}^{3+}} = \frac{0.82}{0.12} = \frac{41}{6} \text{ or } 41:6$$

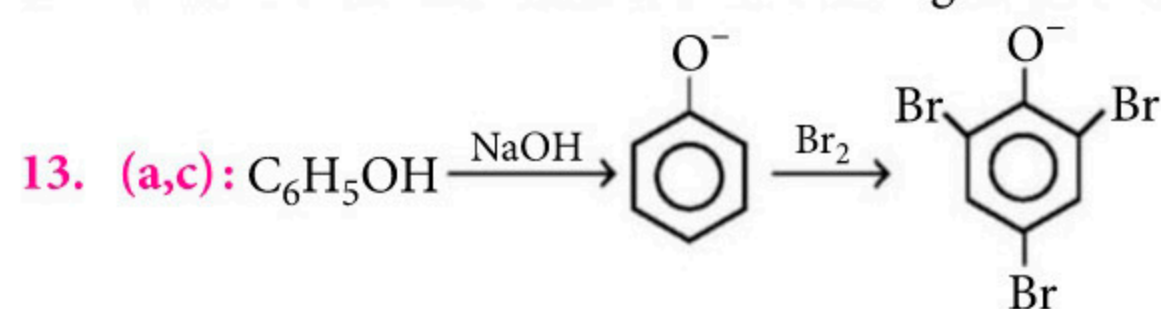
11. (a,b,d): The substances which have lower reduction potentials are strong reducing agents while those which have higher reduction potentials are stronger oxidising agents.

$\therefore E_{M^{n+}/M}^0$  for V, Fe and Hg are lower than that of  $\text{NO}_3^-$ , so  $\text{NO}_3^-$  will oxidise V, Fe and Hg.



With increase in value of  $n$  acidic nature increases, thermal stability decreases and oxidising nature decreases.

$\text{Cl}-\text{O}$  bond order decreases with decreasing value of  $n$ .



Due to presence of  $-ve$  charge on the oxygen atom of phenoxide ion there is strong activation of benzene ring as a result we get trisubstituted product. (a) and (c) can be intermediates.

14. (a,b,c)

15. (b,c): Due to resonance,



$\text{C}-\text{N}$  bond acquires some double bond character, hence shorter in length and shows a planar structure.



**CLASS-XII**

*for*

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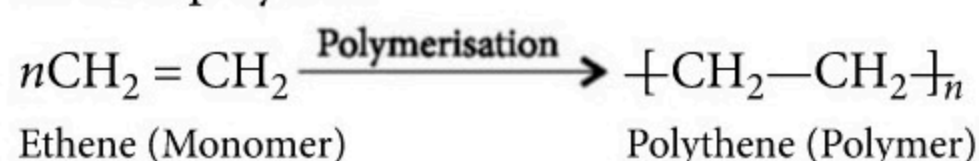
**Unit  
8**

## Polymers | Chemistry in Everyday Life

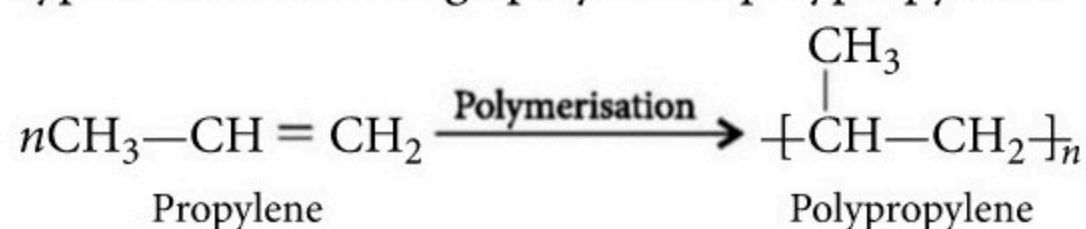
### Polymers

#### POLYMERS

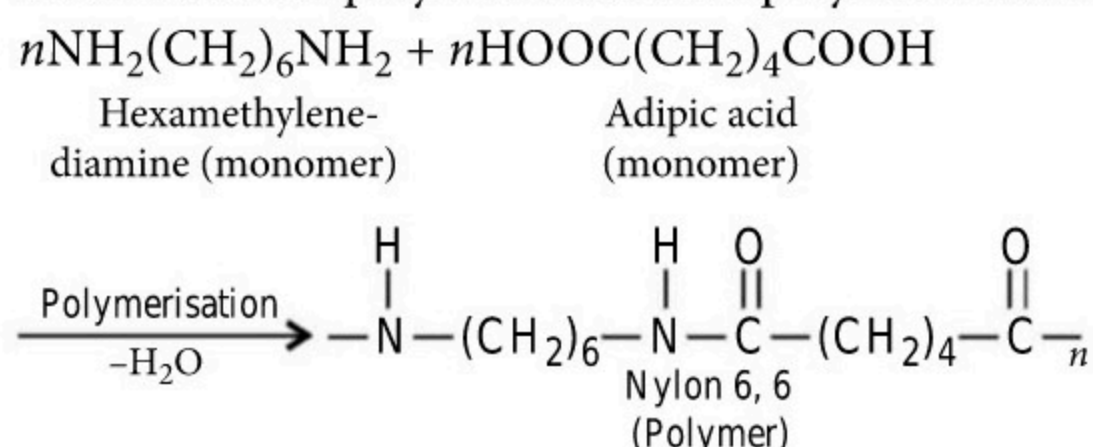
- The process of formation of a bigger molecule from any simpler molecules through mutual bonding is called polymerisation. The simpler molecules undergoing polymerisation are known as monomers and the bigger molecule formed is called a polymer.



- Homopolymers** : Polymers made up of only one type of monomers *e.g.*, polythene, polypropylene.



- Copolymers** : Polymers made up of two or more types of monomers *e.g.*, nylon 6,6. The process of formation of copolymer is called copolymerisation.



- Copolymers have better physical and mechanical properties, which can be changed by varying the amount of each monomer.


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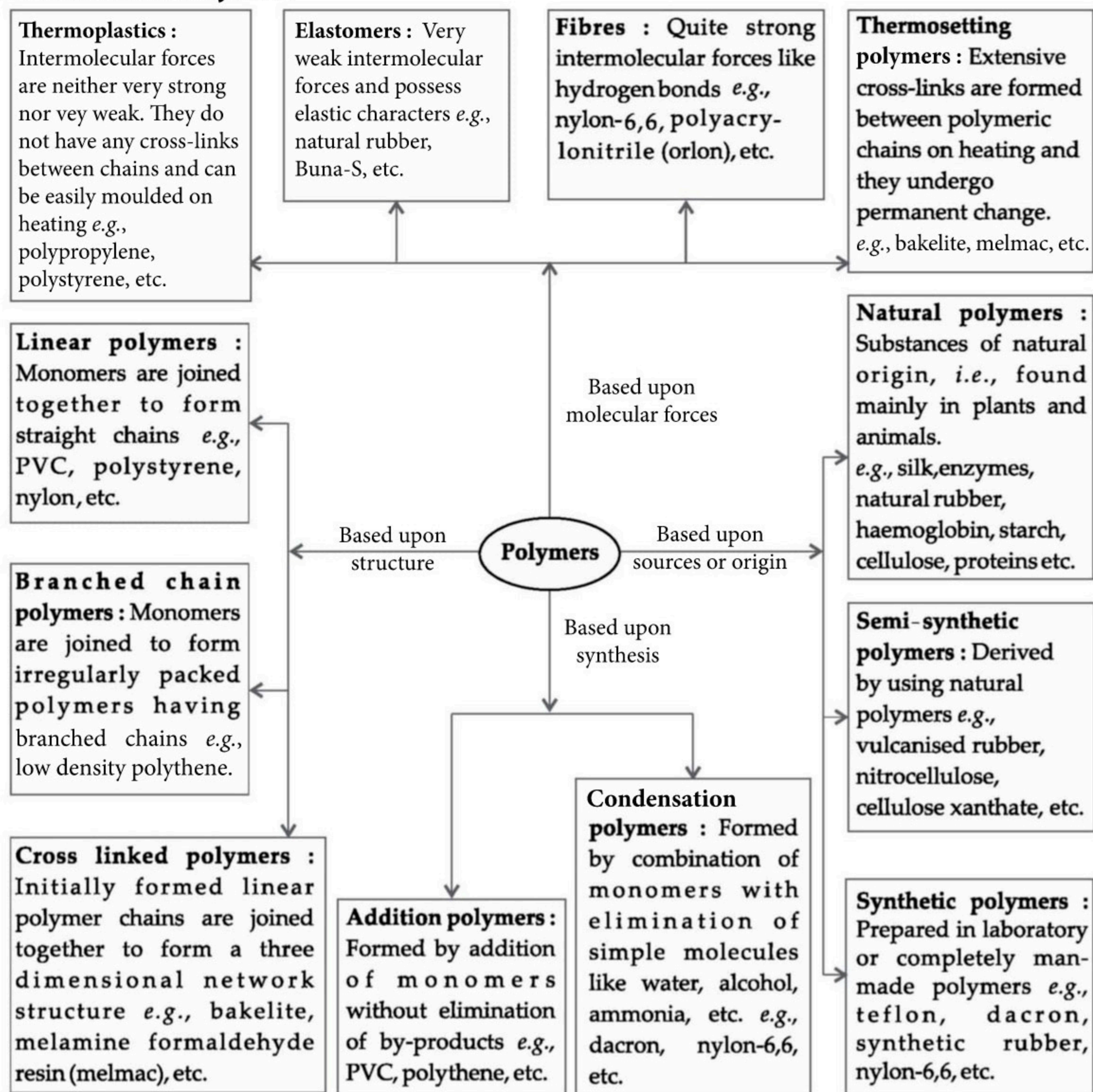


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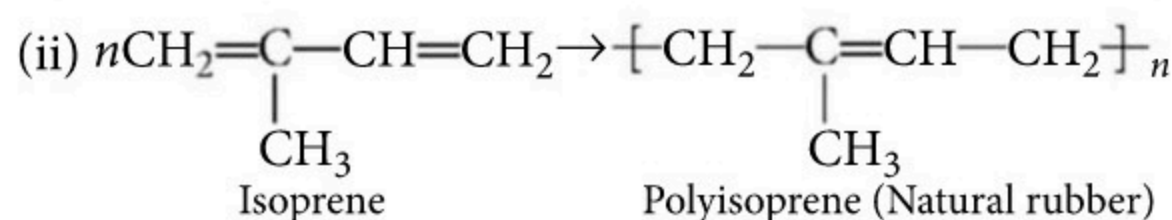
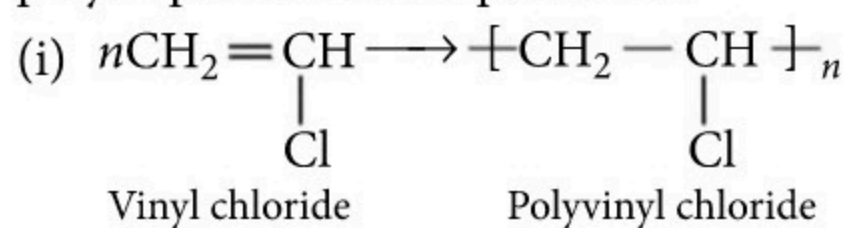


## Classification of Polymers



## Types of Polymerisation Reaction

- Addition polymerisation :** In addition polymerisation, the unsaturated monomeric molecules undergo repeated addition reactions in the presence of catalysts like  $O_2$ , organic peroxides. Some examples of addition polymers are polythene from ethylene, polypropylene from propylene, polyisoprene from isoprene. etc.



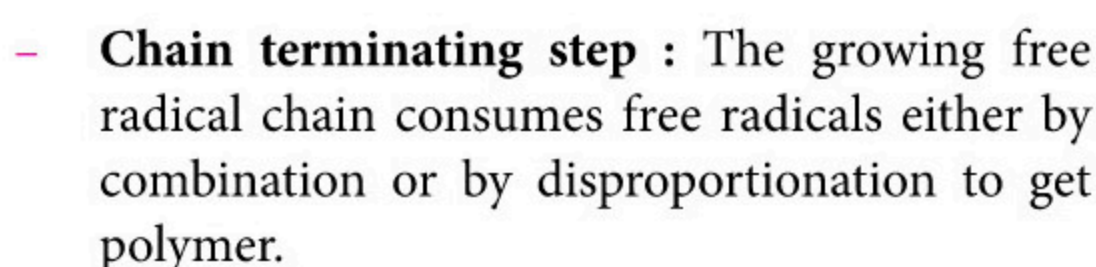
## Mechanism of Addition Polymerisation or Chain Growth Polymerisation

- Free radical addition polymerisation :** This is initiated by adding a substance which generate free radicals called an initiator *e.g.*, benzoyl peroxide.
- Chain initiation :** Peroxide molecules break up and generate free radicals which act as initiators and react with monomer molecules



$$R-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{O}-\text{O}-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-R \xrightarrow{\Delta} 2R-\overset{\overset{\text{O}}{\parallel}}{\text{C}}-\text{O}^{\bullet} \downarrow 2\dot{R} + 2\text{CO}_2$$

- **Chain propagating step :** The free radical thus formed adds to the double bond of the monomer to form larger free radical.


$$2R-(CH_2-CH_2)_nCH_2-\dot{C}H_2 \longrightarrow$$

$$R-(CH_2CH_2)_nCH_2CH_2CH_2CH_2-(CH_2CH_2)_nR$$
$$2R-(CH_2-CH_2)_nCH_2-\dot{C}H_2 \longrightarrow$$

$$R-(CH_2-CH_2)_nCH=CH_2$$

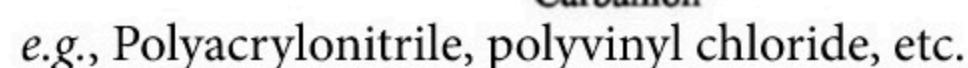
Alkene

$$+ R-(CH_2-CH_2)_nCH_2-CH_3$$

Alkane

- $$\begin{aligned} \text{H}_2\text{SO}_4 &\longrightarrow \text{H}^+ + \text{HSO}_4^- \\ \text{H}^+ + \text{CH}_2=\text{CH}_2 &\longrightarrow \text{CH}_3-\overset{+}{\text{C}}\text{H}_2 \\ &\quad \text{Carbocation} \end{aligned}$$

- Anionic addition polymerisation :** Initiated by strong bases such as  $\text{NaNH}_2$ ,  $\text{C}_4\text{H}_9\text{Li}$  and Grignard reagent, etc.



- $$\begin{array}{c}
 n\text{HOOC}-\text{C}_6\text{H}_4-\text{COOH} + \text{HO}-\text{CH}_2-\text{CH}_2-\text{OH} \\
 \text{Terephthalic acid} \qquad \qquad \text{Ethylene glycol} \\
 \xrightarrow[ -\text{H}_2\text{O} ]{ 420-460 \text{ K} } \left[ \text{OC}-\text{C}_6\text{H}_4-\text{CO}-\text{O}-\text{CH}_2-\text{CH}_2-\text{O} \right]_n \\
 \text{Terylene (Dacron)}
 \end{array}$$

(i) Adipic acid + hexamethylenediamine  $\rightarrow$  Nylon 6, 6 + H<sub>2</sub>O

(ii) Phenol + formaldehyde  $\rightarrow$  Bakelite +  $H_2O$

(iii) Urea + formaldehyde  $\rightarrow$  Urea-formaldehyde resin + H<sub>2</sub>O

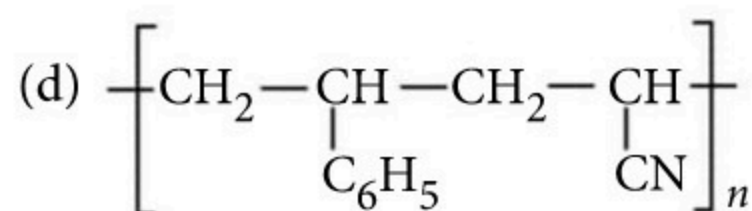
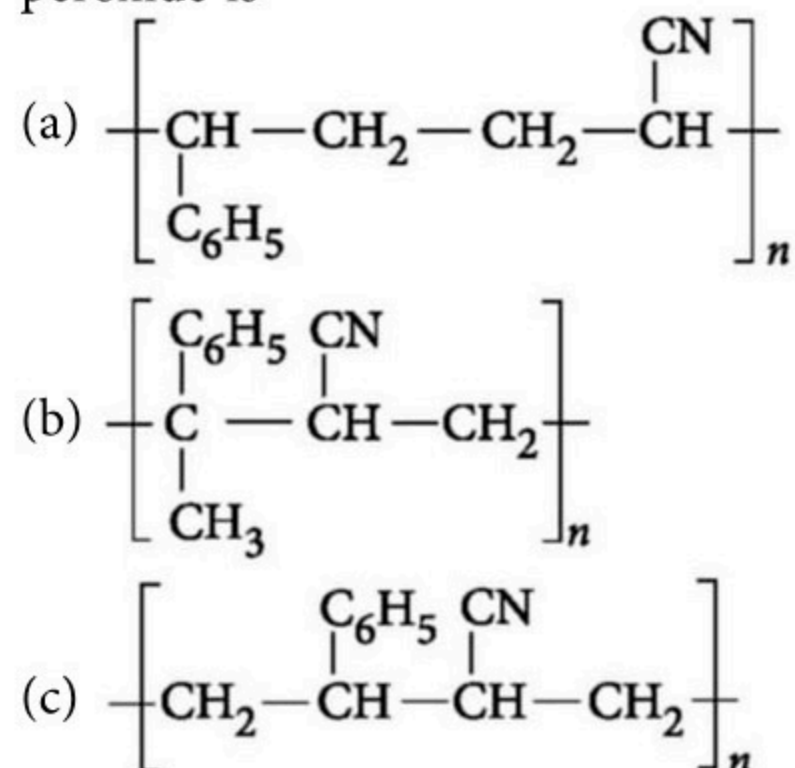
Low density polyethylene (LDPE) ← Polyethylene → High density polyethylene (HDPE)

- Linear addition or chain growth homopolymer.
- By heating ethylene at 333-343 K and 6-7 atm in presence of Ziegler-Natta catalyst.
- Coordination polymerisation
- Linear molecules, closely packed.
- High density ( $0.97 \text{ g/cm}^3$ ), high melting point (403 K).
- Translucent
- Chemically inert, quite harder, greater tensile strength.
- Used for manufacturing containers, housewares, pipes, etc.



### ✓ PEEP INTO PREVIOUS YEARS

1. The copolymer formed by addition polymerization of styrene and acrylonitrile in the presence of peroxide is



(JEE Main Online 2018)

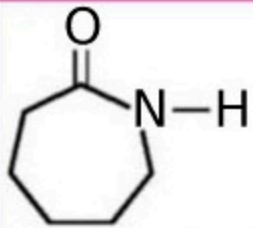
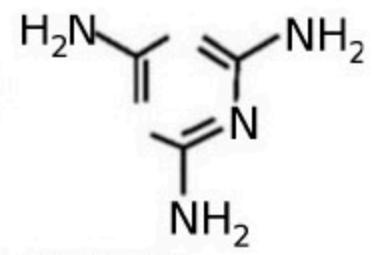
2. Regarding cross-linked or network polymers, which of the following statements is incorrect?
- (a) They contain covalent bonds between various linear polymer chains.
- (b) They are formed from bi- and tri-functional monomers.
- (c) Examples are bakelite and melamine.
- (d) They contain strong covalent bonds in their polymer chains.

(NEET 2018)

### Some Commercially Important Polymers

| Name of polymer                               | Structure   | Monomer   | Uses  |
|---|---|---|---|
| Polyethylene                                  | $\left( \text{CH}_2 - \text{CH}_2 \right)_n$  | $\text{CH}_2 = \text{CH}_2$   | Used as insulator, anticorrosive, packing material, household and laboratory wares. |
| Polystyrene                                   | $\left( \underset{\text{C}_6\text{H}_5}{\text{CH}} - \text{C} \right)_n$  | $\text{C}_6\text{H}_5 - \text{CH} = \text{CH}_2$  | Used as insulator, wrapping material, manufacture of toys and household articles.   |
| Polyvinyl chloride                            | $\left( \text{H}_2 - \underset{\text{Cl}}{\text{C}} \right)_n$  | $\text{CH}_2 = \text{CHCl}$   | Manufacture of raincoats, hand bags, vinyl flooring and leather clothes.            |
| Polytetrafluoro ethylene (PTFE) or Teflon     | $\left( \text{CF}_2 - \text{CF}_2 \right)_n$  | $\text{CF}_2 = \text{CF}_2$   | As lubricant, insulator and making cooking wares.                                   |
| Poly methyl methacrylate (PMMA) or Plexiglass | $\left( \text{H}_2 - \underset{\text{COOC}}{\overset{\text{CH}_3}{\text{C}}} \right)_n$                           | $\text{CH}_2 = \underset{\text{COOCH}_3}{\overset{\text{CH}_3}{\text{C}}}$                                      | Used as substitute of glass and for making decorative materials.                    |
| Polyacrylonitrile (Orlon)                     | $\left( \text{H}_2 - \underset{\text{C}}{\text{C}} \right)_n$   | $\text{CH}_2 = \text{CHCN}$   | In making synthetic fibres and synthetic wool.                                      |
| Styrene butadiene rubber (SBR or Buna-S)      | $\left( \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \underset{\text{C}_6\text{H}_5}{\text{CH}} \right)_n$ | (a) $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$<br>(b) $\text{C}_6\text{H}_5 - \text{CH} = \text{CH}_2$ | In making automobile tyres and footwears.   |



|  |  |   |   |
|--|--|---|---|
| Nitrile rubber<br>(Buna - N)                         | $\left( \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_2 - \underset{\text{CN}}{\text{CH}} \right)_n$   | (a) $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$<br>(b) $\text{H}_2\text{C} = \text{CH} - \text{CN}$   | In making oil seals, hoses and tank linings.                                |
| Neoprene   | $\left( \text{H}_2 - \underset{\text{Cl}}{\text{C}} = \text{C} - \text{C} \right)_n$   | $\text{CH}_2 = \underset{\text{Cl}}{\text{C}} - \text{CH} = \text{CH}_2$  | Used as insulator, in making conveyor belts and printing rollers.           |
| Polyethyl acrylate                                   | $\left( \text{H}_2 - \underset{\text{COOC}_2\text{H}_5}{\text{CH}} \right)_n$  | $\text{CH}_2 = \text{CH} - \text{COOC}_2\text{H}_5$   | In making films, house pipes and finishing fabrics.                         |
| Terylene<br>(Dacron)                                 | $\left( \text{OC} - \text{C}_6\text{H}_4 - \text{COOCH}_2\text{CH}_2\text{O} \right)_n$  | (a) $\text{HOOC} - \text{C}_6\text{H}_4 - \text{COOH}$<br>(b) $\text{HO} - \text{CH}_2 - \text{CH}_2 - \text{OH}$   | For making films, house pipes and finishing fabrics.                        |
| Glyptal  | $\left( \text{OCH}_2 - \text{CH}_2\text{OOC} - \text{C}_6\text{H}_4 - \text{CO} \right)_n$   | (a) $\text{HOOC} - \text{C}_6\text{H}_4 - \text{COOH}$<br>(b) $\text{HO} - \text{CH}_2 - \text{CH}_2 - \text{OH}$   | As binding material in preparation of mixed plastics and paints.            |
| Nylon-6  | $\left( \text{H} - (\text{CH}_2)_5 - \underset{\text{O}}{\underset{\text{  }}{\text{C}}} \right)_n$  |    | In making fibres, plastics, tyre cords and ropes.                           |
| Nylon-6, 6   | $\left( \text{NH}(\text{CH}_2)_6\text{NHCO}(\text{CH}_2)_4\text{CO} \right)_n$   | (a) $\text{HOOC} - (\text{CH}_2)_4 - \text{COOH}$<br>(b) $\text{H}_2\text{N} - (\text{CH}_2)_6 - \text{NH}_2$   | In making brushes, synthetic fibres, parachutes, ropes and carpets.         |
| Bakelite   | $\left( \text{C}_6\text{H}_3(\text{OH})_2 - \text{CH}_2 - \text{C}_6\text{H}_3(\text{OH})_2 - \text{CH}_2 \right)_n$   | (a) $\text{HCHO}$<br>(b) $\text{C}_6\text{H}_5\text{OH}$  | For making gears, protective coating and electrical fittings.               |
| Urea-formaldehyde resin                              | $\left( \text{NH} - \text{CO} - \text{NH} - \text{CH}_2 \right)_n$   | (a) $\text{HCHO}$<br>(b) $\text{NH}_2\text{CONH}_2$   | For making unbreakable cups and laminated sheets.                           |
| Melamine-formaldehyde resin                          | $\left( \text{H}_2\text{C} - \text{HN} - \text{C}_6\text{H}_3\text{N}_3 - \text{NH} - \text{CH}_2 \right)_n$   | (a) <br>(b) $\text{HCHO}$  | In making non-breakable plastic crockery i.e., unbreakable cups and plates. |
| Poly-β-hydroxy butyrate-co-β-hydroxy valerate (PHBV) | $\left( \text{O} - \underset{\text{R}}{\text{CH}} - \text{CH}_2 - \underset{\text{O}}{\underset{\text{  }}{\text{C}}} \right)_n$<br>$\text{R} = \text{CH}_3-, \text{C}_2\text{H}_5-$ | (a) $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} - \text{CH}_2 - \text{COOH}$<br>(b) $\text{C}_2\text{H}_5 - \underset{\text{OH}}{\text{CH}} - \text{CH}_2 - \text{COOH}$ | As packaging, orthopaedic devices and in controlled drug release.           |



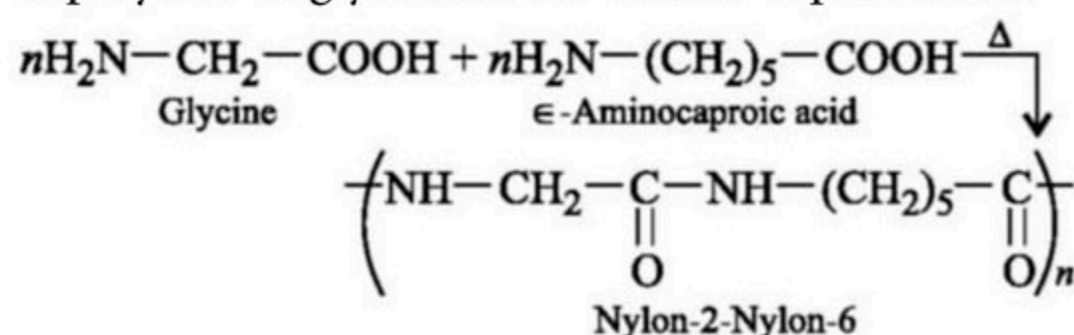
## Rubber

- **Natural rubber :**
  - It is obtained as latex from rubber tree.
  - It is highly elastic.
  - It is *cis*-1,4-Polyisoprene.
  - All *trans* configuration occurs as *Gutta-Percha*, which is non-elastic.
- **Synthetic rubber :**
  - It is obtained by polymerizing certain organic compounds which may have properties similar to rubber and some additional desirable properties.
  - Most of these polymers are derived from butadiene derivatives. For example, neoprene, Buna-S, Buna-N, thiokol, polyurethane rubber etc.
  - **Neoprene or polychloroprene :** Prepared by free radical polymerisation in presence of  $O_2$  or peroxides. It has greater stability to aerial oxidation and it is resistant to action of vegetables or mineral oils.
  - **Buna-S :** Prepared by free radical copolymerisation of 1, 3-butadiene and styrene. It is very tough, possesses high abrasion resistance, high load bearing capacity.
  - **Buna-N :** Prepared by copolymerisation of 1, 3-butadiene and acrylonitrile in the presence of a peroxide catalyst.
  - **Thiokol :** Prepared by copolymerisation of ethylenedichloride with sodium tetrasulphide in presence of magnesium hydroxide.
- **Vulcanization of rubber :** It is a process of treating natural rubber with sulphur and an appropriate additive at a temperature range of 373 to 415 K, to modify its properties.
  - On vulcanization sulphur forms cross-links at the reactive sites of the double bonds and gives mechanical strength to the rubber.
  - The extent of hardness or toughness, however, depends upon the amount of sulphur added. Thus, about 5% sulphur is used for making tyre rubber, 20-25% sulphur for making ebonite and 30% sulphur for making battery case rubber.

## Biodegradable Polymers

- Biopolymers disintegrate by enzymatic hydrolysis and to some extent by oxidation and hence are biodegradable.

- Synthetic polymers are non-biodegradable and hence create disposal problem. To overcome this, biodegradable synthetic polymers have been developed.
- **Poly- $\beta$ -hydroxybutyrate-co- $\beta$ -hydroxyvalerate (PHBV) :** It is a copolymer of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid connected with ester linkages.
  - Used in speciality packaging, orthopaedic devices and in controlled drug release.
- **Dextron :** A copolymer of glycolic acid and lactic acid (90 : 10) was the first biodegradable polyester used for stitching of wounds.
- **Nylon-2-Nylon-6 :** It is a step-growth polyamide copolymer of glycine and  $\epsilon$ -amino caproic acid.



## Molecular Mass of Polymers

There are two types of average molecular weight in case of polymers :

- $\bar{M}_n$  = Number average molecular weight
  - $\bar{M}_w$  = Weight average molecular weight
- (a) **Number average molecular weight ( $\bar{M}_n$ )**

$$\bar{M}_n = \frac{\text{Total weight of the molecules}}{\text{Total number of molecules}}$$

$$\bar{M}_n = \frac{n_1M_1 + n_2M_2 + n_3M_3 + \dots}{n_1 + n_2 + n_3 + \dots}$$

$$\bar{M}_n = \frac{\sum n_i M_i}{\sum n_i}$$

$\bar{M}_n$  is generally determined by osmotic pressure method.

- (b) **Weight average molecular weight ( $\bar{M}_w$ )**

$$\bar{M}_w = \frac{w_1M_1 + w_2M_2 + w_3M_3 + \dots}{w_1 + w_2 + w_3 + \dots}$$

[weight ( $w$ ) = no. of moles ( $n$ )  $\times$  molecular weight ( $M$ )]

$\bar{M}_w$  is generally determined by the light scattering method.

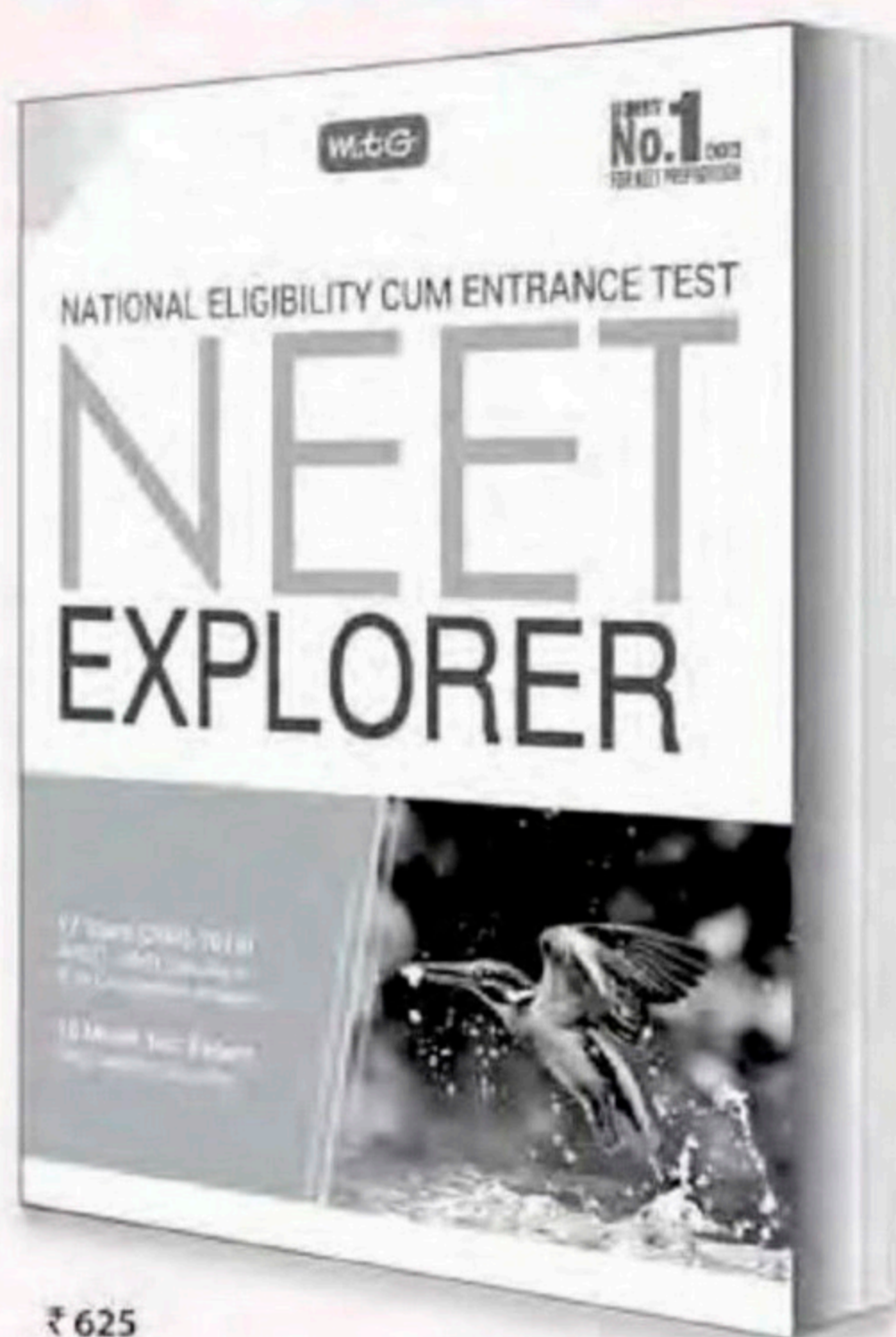
## PDI (Polydispersity Index)

The ratio of the  $\bar{M}_w$  and  $\bar{M}_n$  is called PDI

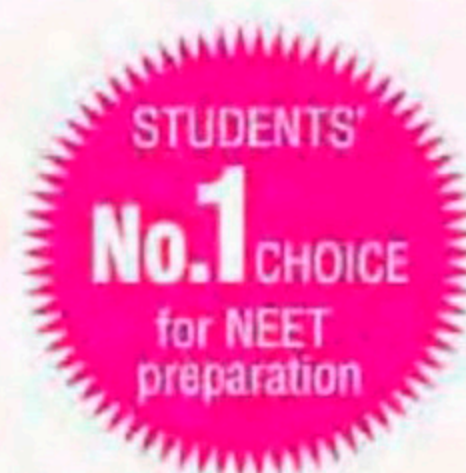
$$PDI = \frac{\bar{M}_w}{\bar{M}_n}$$



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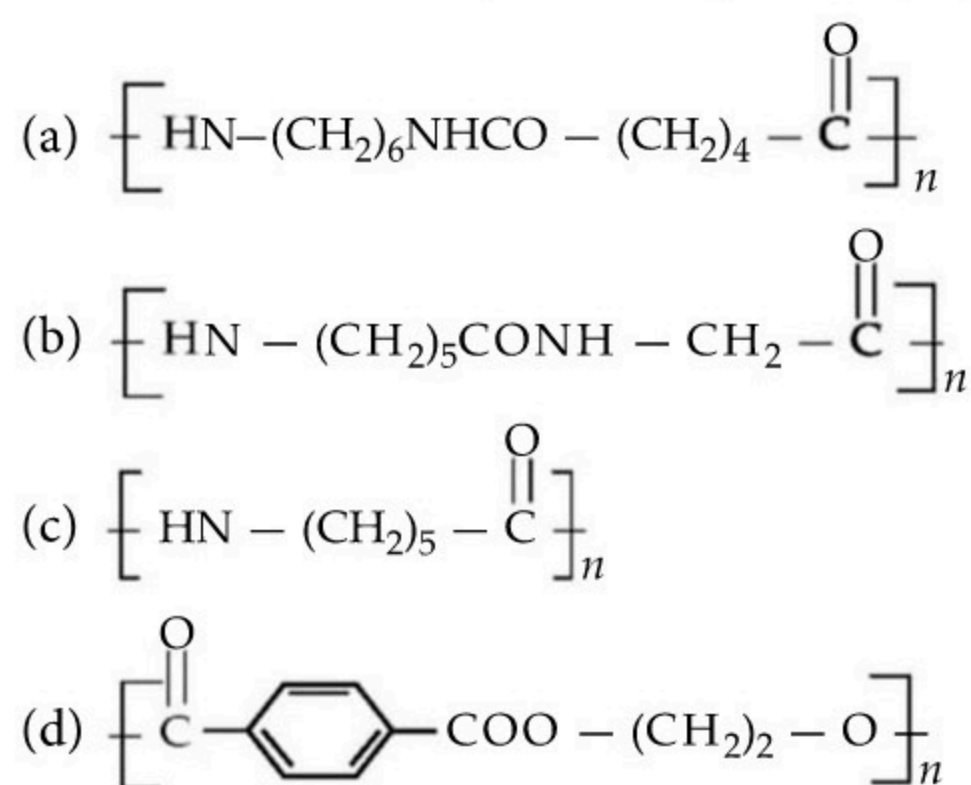


In natural polymers, which are generally mono-dispersed, the P.D.I. is unity ( $\bar{M}_w = \bar{M}_n$ ).

In synthetic polymers, which are poly-dispersed, P.D.I. is greater than unity because  $\bar{M}_w$  is always higher than  $\bar{M}_n$ .

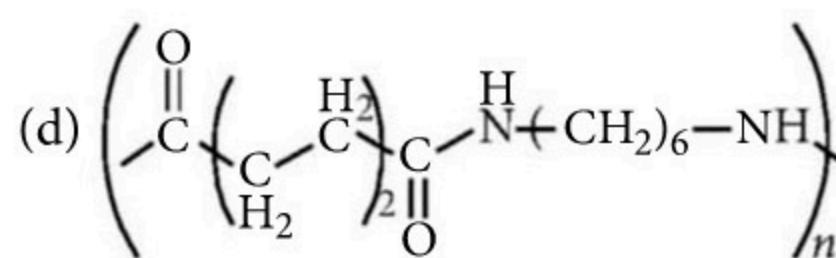
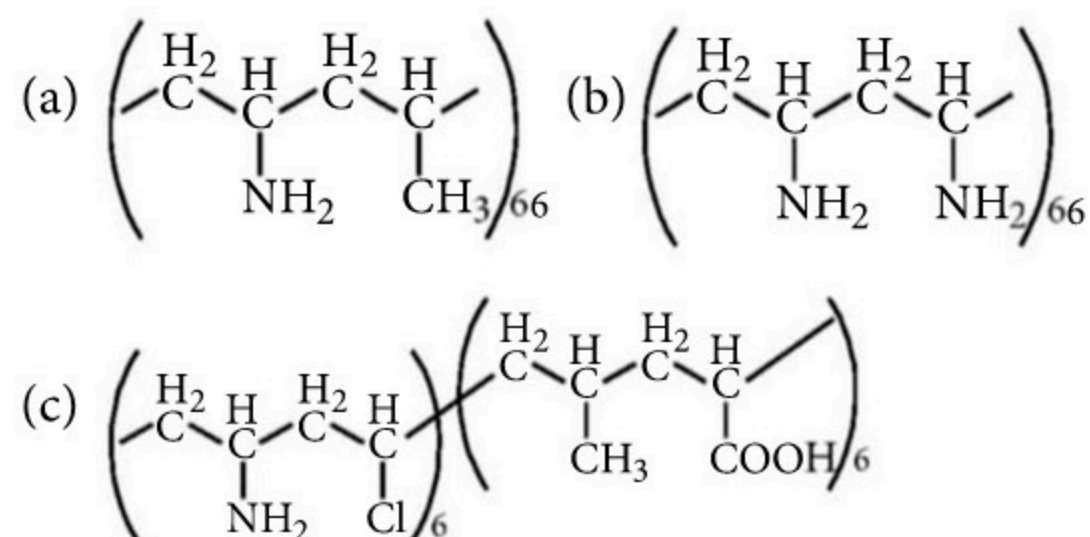
### PEEP INTO PREVIOUS YEARS

3. The biodegradable polymer is  
 (a) buna-S (b) nylon-6,6  
 (c) nylon-2-nylon 6 (d) nylon-6.  
 (NEET 2019)
4. Choose the correct option(s) from the following  
 (a) Teflon is prepared by heating tetrafluoroethene in presence of a persulphate catalyst at high pressure.  
 (b) Natural rubber is polyisoprene containing *trans* alkene units.  
 (c) Nylon-6 has amide linkages.  
 (d) Cellulose has only  $\alpha$ -D-glucose units that are joined by glycosidic linkages.  
 (JEE Advanced 2019)
5. Which of the following is a biodegradable polymer?



(JEE Main Online 2017)

6. Which one of the following structures represents nylon 6, 6 polymer?

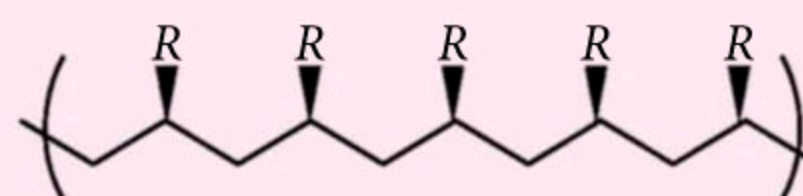


(NEET-II 2016)

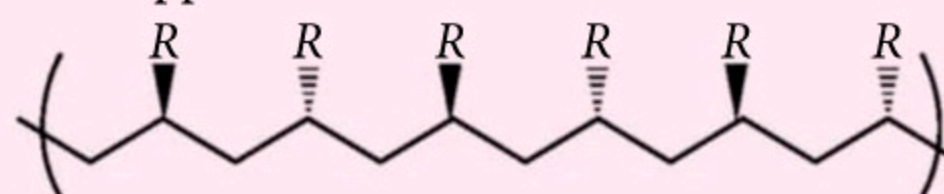
### POINTS FOR EXTRA SCORING

➤ **Coordination Polymerisation** : It is the process in which the polymerisation occurs through formation of coordination complex.

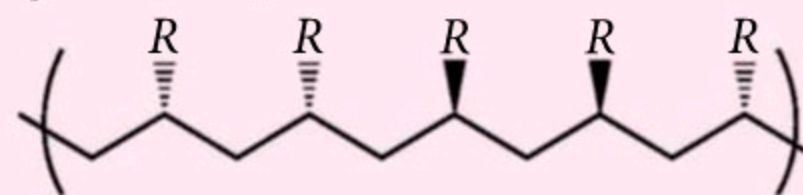
➤ **Isotactic** (meaning-same order) : In this type of arrangement all the methyl groups of propylene lie on the same side.



➤ **Syndiotactic** (meaning-alternating order) : In this case the methyl groups alternate regularly on the opposite side of chain.



➤ **Atactic** (meaning-no order) : In this type of arrangement no particular order is followed.



➤ **Polyurethanes**. These are the condensation polymers of toluene-2,4-diisocyanate and ethylene glycol.

➤ **Ebonite** : It is a highly vulcanised rubber having about 20–30% of sulphur.

➤ **Kevlar** : It is a polyamide obtained by condensation copolymerisation and used in making light weight bullet-proof vests.

➤ **Nomex** : A condensation polyamide used in protective clothing for fire resistance.

➤ **Lexan** : A condensation copolymerisation polycarbonate (polyester) with unusually high impact strength, used for making bullet proof windows and safety helmets.

➤ **Rayon (artificial silk)** : It is chemically similar to cotton but shines like silk. Artificial silk is a polysaccharide while natural silk is a protein (polyamide).



## CHEMICALS IN USE

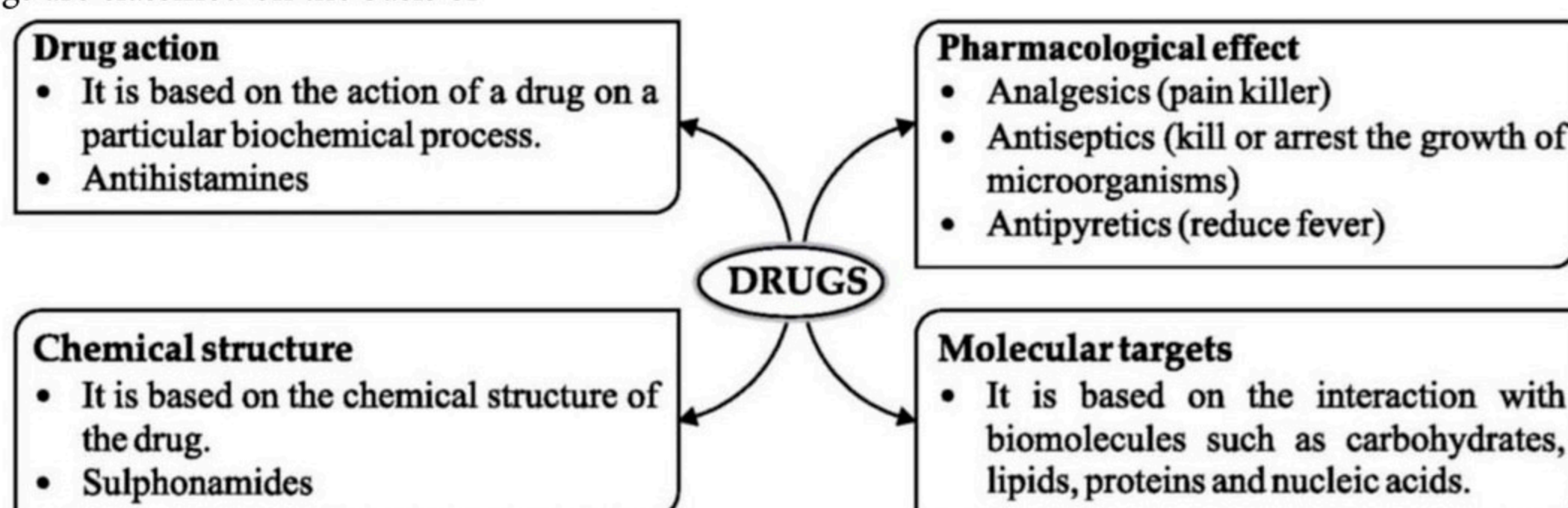
- In various areas, chemicals are used as
  - medicines for the treatment of diseases.
  - food materials
  - cleansing agents like soaps, detergents, household bleaches, tooth pastes, etc.
  - synthetic fibres made up of chemicals only.

## Chemicals in Medicines

- Drugs are the chemicals of low molecular masses ( $\sim 100$ -500 u) which interact with macromolecular targets and produce a therapeutic and useful biological response. These chemicals are called medicines.
- Use of chemicals for therapeutic effect is called chemotherapy.

## Classification of Drugs

- Drugs are classified on the basis of



## Drug Target Interaction

- **Enzymes as drug target :** Drugs inhibit any of the two activities of the enzymes, they can block the binding site of the enzyme and prevent the binding of substrate or they can inhibit the catalytic activity of enzyme.
- **Receptors as drug target :** Proteins which transmit communication to the different parts of the body are called receptors. Receptor proteins are embedded in the cell membrane and receptor changes its shape to accommodate a chemical messenger which brings about transfer of message into the cell.
- **Drug interact with receptors in two ways :**
  - Drugs bind to their receptor sites and inhibit its natural function (antagonists). These are useful when blocking of message is required.
  - Some drugs mimic the natural messenger by switching on the receptor (agonists). These are useful when there is lack of natural chemical messenger.

## Therapeutic Action of Different Classes of Drugs

- **Analgesics :** These are chemical substances which reduce pain. They are classified as :
  - (i) Non-narcotic analgesics and (ii) Narcotic drugs
  - (i) **Non-narcotic analgesics :** Aspirin and paracetamol belong to this class of drugs. They are effective in relieving skeletal pain such as that due to arthritis. They have many other effects such as reducing fever (antipyretic) and preventing platelets coagulation. Aspirin finds use in prevention of heart attacks because of its anti blood clotting action.
  - (ii) **Narcotic analgesics :** Morphine and many of its homologues, when administered in medicinal doses, relieve pain and produce sleep. In poisonous doses, they cause convulsions and ultimately death. These are mainly used for the relief of post operative pain, cardiac pains and pains of terminal cancer.
- **Tranquilizers :** These are chemical substances used for the treatment of stress, mild and severe mental

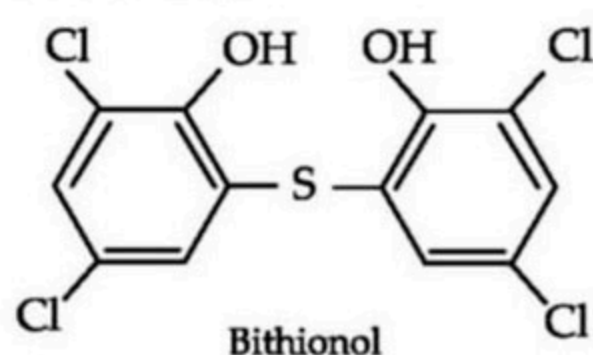


diseases. They are neurologically active drugs and are also called psychotherapeutic drugs, *e.g.*, veronal, amytal, seconal, equanil, chlordiazepoxide, etc.

Veronal, amytal, and seconal are called barbiturates. Barbiturates are hypnotics, *i.e.*, sleep producing agents.

- **Antiseptics** : These are chemicals which either kill or prevent the growth of microorganisms and are applied to the living tissues such as wounds, cuts, ulcers and diseased skin surfaces.

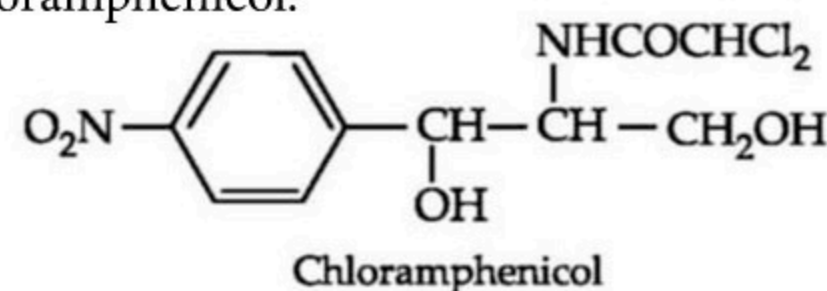
- Dettol is a commonly used antiseptic and it is a mixture of chloroxylenol and terpineol.
- Bithionol is added to soaps to reduce odours produced by bacterial decomposition of organic matter on the skin.



- Tincture of iodine, *i.e.*, 2-3% solution of iodine in alcohol-water mixture is applied on wounds.
- **Disinfectants** : These are also used to kill microorganisms, but they are applied to inanimate objects.
  - Some substances can act both as antiseptic as well as disinfectant by varying the concentration.
  - 0.2% phenol is an antiseptic, whereas its 1% solution is disinfectant.
  - 0.2 - 0.4 ppm chlorine in aqueous solution acts as disinfectant.
- **Antimicrobials** : These are chemical substances used to cure infections due to microorganisms, *e.g.*, sulphadiazine, sulphapyridine, etc.
- **Antifertility drugs** : Chemical substances used to prevent conception or fertilization are called antifertility drugs. These are essentially a mixture of estrogen and progesterone derivatives which are more potent than the natural hormones, *e.g.*, mifepristone, ormeloxifene, etc.
- **Antibiotics** : These drugs are chemical substances produced wholly or partly by chemical synthesis which in low concentration inhibit the growth or destroy microorganisms by intervening in their metabolic processes.
  - The antibiotics may be either bactericidal (kill the organisms in the body) *e.g.*, penicillin, ofloxacin, etc., or bacteriostatic (inhibit the

growth of organisms), *e.g.*, erythromycin, chloramphenicol, etc.

- Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria are said to be broad spectrum antibiotics, *e.g.*, tetracycline, chloromycetin and chloramphenicol.



- Those effective mainly against Gram-positive or Gram-negative bacteria are narrow spectrum antibiotics, *e.g.*, penicillin-G.
- **Antacids** : These are chemicals which neutralize excess acid in the gastric juices and give relief from acid indigestion, acidity, heart burns and gastric ulcers, *e.g.*, magnesium hydroxide, calcium carbonate, etc.
- **Antihistamines** : These drugs diminish or abolish the main actions of histamine released in the body and hence prevent allergic reactions, they are also called anti-allergic drugs, *e.g.*, diphenylhydramine (benadryl), pheniramine maleate (avil), etc.

## Chemicals in Food

- **Preservatives** : These are the chemical substances which are added to the food materials to prevent their spoilage and to retain their nutritive value for long periods. These preservatives prevent the rancidity of food and inhibit the growth or kill the microorganisms.
- The preservation of food by adding sufficient amount of salt to it is called salting. Salt prevents the water from being available for microbial growth.
- The microbial growth in food materials can also be prevented by adding certain chemical substances. The most common preservative used is sodium benzoate ( $C_6H_5COONa$ ). It is metabolised by conversion to hippuric acid,  $C_6H_5CONHCH_2COOH$  which is ultimately excreted through urine.

## Quotable Quote

"Once you replace negative thoughts with positive ones, you'll start having positive results."

**WILLIE NELSON**



- Certain food preservatives such as BHA and BHT are used for edible oils, also act as antioxidants.
- **Artificial sweetening agents** : These are chemical compounds which give sweetening effect to the food and enhance its odour and flavour.

| Artificial sweetener | Sweetness value in comparison to cane sugar |
|----------------------|---|
| Aspartame            | 180   |
| Sucralose            | 650   |
| Alitame              | 2000  |

- **Antioxidants** : These are the chemical substances which prevent oxidation and subsequent spoilage of the food. These act as sacrificial materials, *i.e.*, they are more reactive towards oxygen than the materials they are protecting. They also reduce the rate of involvement of free radicals in the ageing process.

### PEEP INTO PREVIOUS YEARS

7. Among the following, the narrow spectrum antibiotic is
- (a) chloramphenicol      (b) penicillin G  
(c) ampicillin              (d) amoxicillin.

(NEET 2019)

8. The correct match between item-I and item-II is

| Item-I         | Item-II  |
|----------------|--|
| A. Allosteric  | P. Molecule binding effect to the active site of enzyme            |
| B. Competitive | Q. Molecule crucial for inhibitor communication in the body        |
| C. Receptor    | R. Molecule binding to a site other than the active site of enzyme |
| D. Poison      | S. Molecule binding to the enzyme covalently                       |

- (a)  $A \rightarrow P, B \rightarrow R, C \rightarrow Q, D \rightarrow S$   
(b)  $A \rightarrow R, B \rightarrow P, C \rightarrow Q, D \rightarrow S$   
(c)  $A \rightarrow P, B \rightarrow R, C \rightarrow S, D \rightarrow Q$   
(d)  $A \rightarrow R, B \rightarrow P, C \rightarrow S, D \rightarrow Q$

(JEE Main 2019)

9. The reason for “drug induced poisoning” is
- (a) binding reversibly at the active site of the enzyme  
(b) bringing conformational changes in the binding site of enzyme  
(c) binding at the allosteric sites of the enzyme  
(d) binding irreversibly to the active site of the enzyme.

(JEE Main Online 2017)

10. Which of the following is an analgesic?
- (a) Streptomycin      (b) Chloromycetin  
(c) Novalgin            (d) Penicillin

(NEET-I 2016)

### Cleansing Agents

- Soaps are sodium or potassium salts of long chain fatty acids, *e.g.*, stearic, oleic and palmitic acids. Soaps containing sodium salts are prepared by heating glyceryl ester of fatty acid with aqueous NaOH solution and the reaction is known as saponification.
- Only Na/K soaps are soluble in water and are used for cleaning purposes. Generally, potassium soaps are soft to the skin than sodium soaps.
- **Types of soaps**
  - Toilet soaps are prepared by using better grades of fats and oils and care is taken to remove excess alkali. Colour and perfumes are added to make them more attractive.
  - Soaps that float in water are made by beating tiny air bubbles before their hardening. Transparent soaps are made by dissolving the soap in ethanol and then evaporating the excess solvent.
  - In medicated soaps, substances of medicinal value are added. In some soaps, deodorants are added. Shaving soaps contain glycerol to prevent rapid drying. A gum called, rosin is added while making them. It forms sodium rosinate which lathers well. Laundry soaps contain fillers like sodium rosinate, sodium silicate, borax and sodium carbonate.
  - Soap chips are made by running a thin sheet of melted soap onto a cool cylinder and scraping off the soaps in small broken pieces. Soap granules are dried miniature soap bubbles. Soap powders and scouring soaps contain some soap, a scouring agent (abrasive) such as powdered pumice or finely divided sand, and builders like sodium carbonate and trisodium phosphate.



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# CONCEPT MAP

## SURE SHOT TOPICS OF ORGANIC CHEMISTRY (ORGANIC COMPOUNDS CONTAINING HALOGENS, OXYGEN AND NITROGEN)

## SHOT TOPICS OF ORGANIC CHEMISTRY COMPOUNDS CONTAINING HALOGENS, OXYGEN AND NITROGEN)

### Haloalkanes and Haloarenes

#### Haloalkanes

##### Nucleophilic Substitution Reactions

###### $S_N1$ reaction

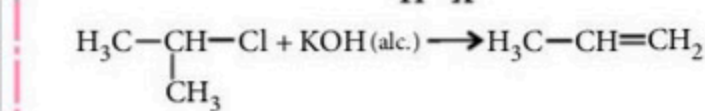
- It is first order reaction.
- Generally carried out in polar protic solvents like water, alcohol and acetic acid.
- Takes place in two steps through carbocation as the intermediate.
- Rate of reaction:  $3^\circ > 2^\circ > 1^\circ > \text{Methyl halides}$
- Tends to proceed with weak nucleophiles, e.g.,  $\text{CH}_3\text{OH}$ ,  $\text{H}_2\text{O}$ ,  $\text{CH}_3\text{CH}_2\text{OH}$ , etc.
- Both retention and inversion of configuration takes place, racemic mixture is obtained.

###### $S_N2$ reaction

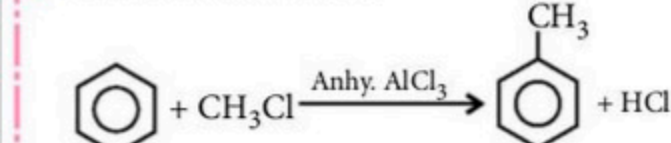
- It is second order reaction.
- Carried out in polar aprotic solvents like acetone, DMSO, acetonitrile or DMF.
- Takes place in one step through transition state.
- Rate of reaction:  $\text{CH}_3 > 1^\circ > 2^\circ > 3^\circ$  halides
- Lesser the steric hindrance in transition state, faster will be the reaction.
- Tends to proceed with strong nucleophiles, e.g.,  $\text{CH}_3\text{O}^-$ ,  $\text{CN}^-$ ,  $\text{OH}^-$ , etc.
- Inversion of configuration takes place (Walden inversion).

##### Chemical Properties

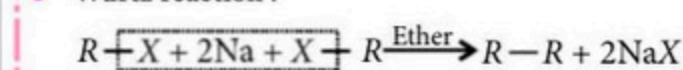
- Dehydrohalogenation:  $\text{R}-\text{CH}_2-\text{CH}_2-\text{X} \xrightarrow{\text{Base}} \text{R}-\text{CH}=\text{CH}_2 + \text{HX}$



##### Friedel-Crafts reaction:



##### Wurtz reaction:



##### Elimination reactions

- E1: In 2 steps: Reactivity of alkyl halides  $3^\circ > 2^\circ > 1^\circ$
- E2: In 1 step: Via transition state. Favourable  $\rightarrow 1^\circ$  alkyl halide.

#### Haloarenes

- The aryl halides are relatively less reactive towards nucleophilic substitution reactions as compared to alkyl halides. This low reactivity can be attributed due to the following factors:
- The C-X bond in halobenzene has a partial double bond character due to involvement of halogen electrons in resonance with benzene ring.
- The C-X bond in aryl halides is less polar as compared to that in alkyl halides as  $sp^2$  hybridised carbon is more electronegative than  $sp^3$  hybridised carbon.

### Alcohols, Phenols and Ethers

#### Alcohols

##### Preparation

- By acid catalysed hydration:  $\text{CH}_3\text{CH}=\text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$
- By reduction of aldehydes and ketones:  $\text{RCHO} + \text{H}_2 \xrightarrow{\text{Pd}} \text{RCH}_2\text{OH}$ ;  $\text{RCOR}' \xrightarrow{\text{NaBH}_4} \text{R}-\text{CH}(\text{OH})-\text{R}'$
- From Grignard reagents:  $\text{RCHO} + \text{R}'\text{MgX} \xrightarrow{\text{H}_2\text{O}} \text{R}-\text{CH}(\text{OH})-\text{R}'$

##### Chemical Properties

- Dehydration:  $\text{C}_2\text{H}_5\text{OH} \xrightarrow[443\text{ K}]{\text{H}_2\text{SO}_4} \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$   
Acid catalysed dehydration of alcohols follows carbocation mechanism. Thus, relative ease of dehydration of alcohols follows the following order:  $3^\circ > 2^\circ > 1^\circ$
- Oxidation:  $\text{RCH}_2\text{OH} \xrightarrow{[\text{O}]} \text{R}-\text{CHO} \xrightarrow{[\text{O}]} \text{R}-\text{COOH}$   
Aldehyde Carboxylic acid

#### Phenols

##### Preparation

- Kolbe's reaction:  $\text{C}_6\text{H}_5\text{OH} \xrightarrow{\text{NaOH}} \text{C}_6\text{H}_5\text{ONa} \xrightarrow[\text{(ii) H}^+]{\text{(i) CO}_2} \text{C}_6\text{H}_4(\text{OH})\text{COOH}$   
2-Hydroxybenzoic acid (Salicylic acid)
- Reimer-Tiemann reaction:  $\text{C}_6\text{H}_5\text{OH} \xrightarrow[\text{H}^+]{\text{CHCl}_3 + \text{aq. NaOH}} \text{C}_6\text{H}_4(\text{OH})\text{CHO}$   
Salicylaldehyde

#### Ethers

##### Preparation

- From alcohols by dehydration:  $2\text{ROH} \xrightarrow[413\text{ K}]{\text{H}_2\text{SO}_4} \text{ROR}$
- From alkyl halide:  $\text{R}-\text{X} + \text{RONa} \xrightarrow{-\text{NaX}} \text{ROR}$   
(Williamson synthesis)

##### Chemical Properties

- Friedel-Crafts reaction:  $\text{C}_6\text{H}_5\text{OCH}_3 + \text{CH}_3\text{Cl} \xrightarrow{\text{Anhyd. AlCl}_3} \text{C}_6\text{H}_4(\text{OCH}_3)_2 + \text{HCl}$   
2-Methoxytoluene (Minor) 4-Methoxytoluene (Major)

### Aldehydes, Ketones and Carboxylic acids

#### Aldehydes and Ketones

##### Preparation

- Oxidation of alcohols:  $\text{RCH}_2\text{OH} + [\text{O}] \xrightarrow[\text{H}_2\text{SO}_4 (\text{dil.})]{\text{K}_2\text{Cr}_2\text{O}_7} \text{RCHO} + \text{H}_2\text{O}$
- Gatterman-Koch reaction:  $\text{C}_6\text{H}_6 \xrightarrow[\text{Anhyd. AlCl}_3, \text{CuCl}]{\text{CO, HCl}} \text{C}_6\text{H}_5\text{CHO}$
- Friedel-Crafts acylation:  $\text{C}_6\text{H}_6 \xrightarrow[\text{Anhyd. AlCl}_3]{\text{RCOCl}} \text{C}_6\text{H}_5\text{COR}$
- Etard reaction:  $\text{C}_6\text{H}_5\text{CH}_3 \xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) CrO}_2\text{Cl}_2 \text{ in CS}_2} \text{C}_6\text{H}_5\text{CHO}$
- Rosenmund reduction:  $\text{RCOCl} + \text{H}_2 \xrightarrow[\text{boiling xylene}]{\text{Pd-BaSO}_4, \text{S}} \text{RCHO} + \text{HCl}$

##### Chemical Properties

- Nucleophilic addition reactions: Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons.
- Haloform reaction: Given by compounds having  $\text{CH}_3\text{CO}-$  group or  $\text{CH}_3\text{CH}(\text{OH})-$  group.  
 $\text{RCOCH}_3 \xrightarrow{\text{NaOX}} \text{RCOONa} + \text{CHX}_3$   
Haloform
- Aldol condensation: Aldehydes and ketones having at least one  $\alpha$ -H atom undergo a reaction in the presence of dilute alkali as catalyst to form  $\beta$ -hydroxy aldehydes (aldols) or  $\beta$ -hydroxy ketones (ketols), respectively.  
The aldol and ketol readily lose water to give  $\alpha, \beta$ -unsaturated carbonyl compounds.
- Cannizzaro reaction: Aldehydes which do not have  $\alpha$ -H atom undergo disproportionation on heating with concentrated alkali.

#### Carboxylic Acids

##### Chemical Properties

- Hydroxyl group of acids is more acidic than the hydroxyl group of alcohols and phenols.
- Acidity order: Carboxylic acids > Phenols > Alcohols
- More is the electronegativity of the atom attached to the carboxyl group, more will be the acidity.
- Decarboxylation:  $\text{R}-\text{COOH} \xrightarrow[\Delta]{\text{NaOH and CaO}} \text{RH} + \text{Na}_2\text{CO}_3$
- Hell-Volhard-Zelinsky reaction:  $\text{R}-\text{CH}_2-\text{COOH} \xrightarrow[\text{(ii) H}_2\text{O}]{\text{(i) X}_2/\text{Red P}} \text{R}-\text{CH}(\text{X})-\text{COOH}$   
 $\text{R}-\text{CH}_2-\text{COOH} + 6\text{HI} \xrightarrow[473\text{ K}]{\text{Red P}} \text{RCH}_2\text{CH}_3 + 2\text{H}_2\text{O} + 3\text{I}_2$
- Electrophilic aromatic substitution:  $\text{C}_6\text{H}_5\text{COOH} \xrightarrow[\text{Conc. H}_2\text{SO}_4, \Delta]{\text{Conc. HNO}_3} \text{C}_6\text{H}_4(\text{NO}_2)\text{COOH}$   
 $\text{C}_6\text{H}_5\text{COOH} \xrightarrow[\Delta]{\text{Br}_2, \text{FeBr}_3} \text{C}_6\text{H}_4(\text{Br})\text{COOH}$

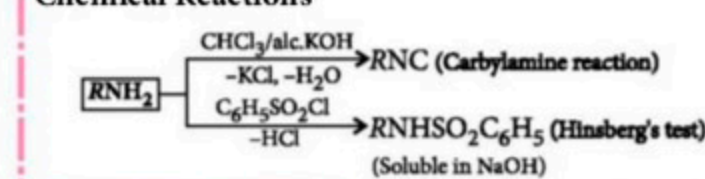
### Amines

#### Aliphatic Amines

##### Chemical Properties

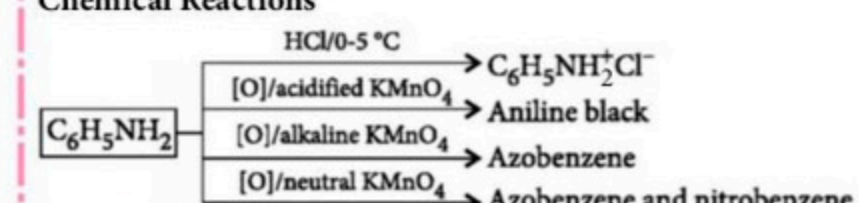
- Basic character of amines: Amines are basic in nature due to the presence of lone pair of electrons on nitrogen atom.
- Aliphatic amines are stronger bases than ammonia due to +I effect of alkyl groups present in amines.
- Aromatic amines are weaker bases than ammonia due to -I effect of aryl group.
- Beside inductive effect, there are other effects like steric effect, solvation effect, resonance effect which affect the basic strength of amines.
- In gaseous phase, the order of basicity of amines is  $3^\circ \text{ amine} > 2^\circ \text{ amine} > 1^\circ \text{ amine} > \text{NH}_3$ .
- In aqueous phase, despite of inductive effect, solvation effect and steric hindrance also play an important role. Thus, the order of basicity of amines is  $(\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N} > \text{C}_2\text{H}_5\text{NH}_2 > \text{NH}_3$  and  $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$

##### Chemical Reactions



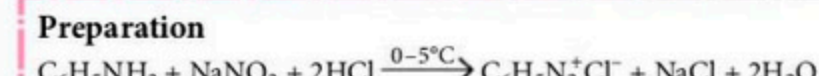
#### Aniline

##### Chemical Reactions

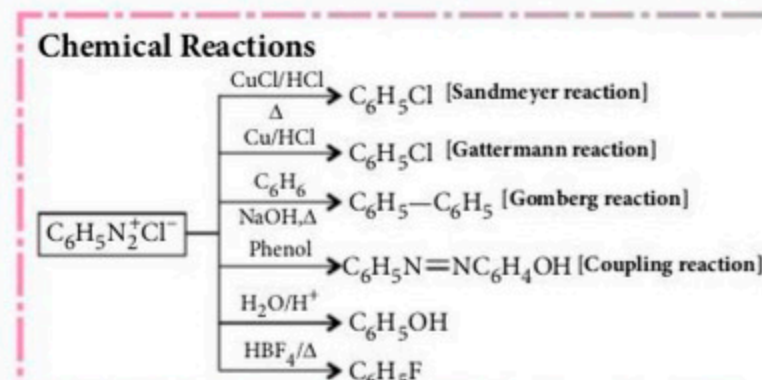


#### Diazonium Salts

##### Preparation



##### Chemical Reactions



### Aldehydes, Ketones and Carboxylic acids

#### Aldehydes and Ketones

##### Preparation

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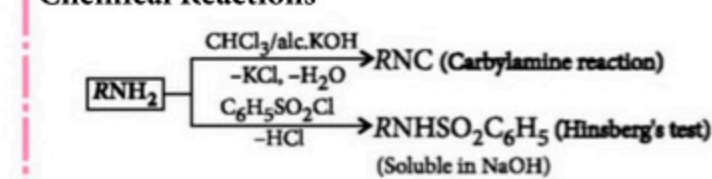
### Amines

#### Aliphatic Amines

##### Chemical Properties

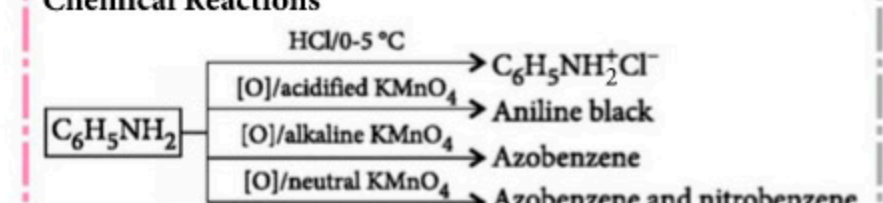
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##### Chemical Reactions



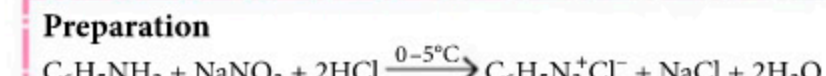
#### Aniline

##### Chemical Reactions

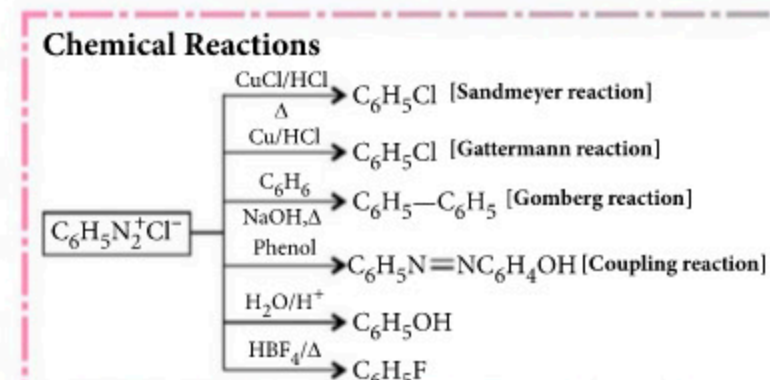


#### Diazonium Salts

##### Preparation



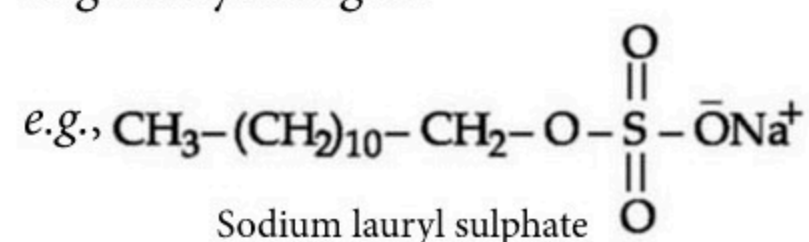
##### Chemical Reactions





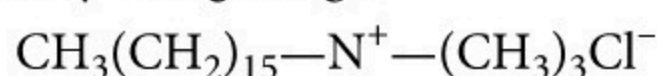
- **Detergents** : These are the materials which are used for cleaning purposes. They are also called soapless soaps.

- **Anionic detergents** : Their polar head is negatively charged.



Such detergents are used to wash clothes.

- **Cationic detergents** : Their polar head is positively charged e.g.,

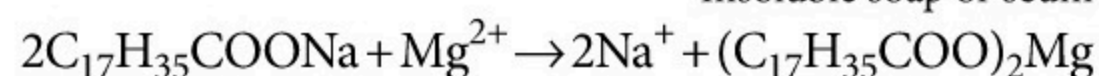
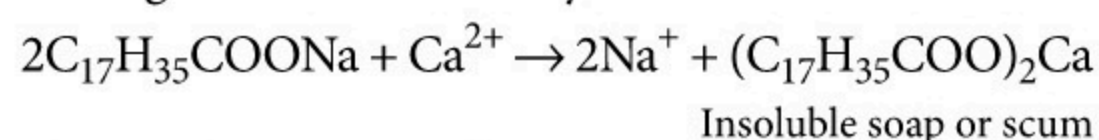


Trimethylhexadecylammonium chloride

These are used as fabric softener and hair conditioner.

- **Non-ionic detergents** : Their polar head is neutral e.g., Polyethyleneglycol stearate,  $\text{CH}_3(\text{CH}_2)_{16}\text{COO}(\text{CH}_2\text{CH}_2\text{O})_n\text{CH}_2\text{CH}_2\text{OH}$   
Such detergents are used in dish washers.

- **Action of soap in hard water** : Hard water contains  $\text{Ca}^{2+}$  or  $\text{Mg}^{2+}$  ions which react with sodium or potassium salts of fatty acids (soap) to form calcium or magnesium salts of fatty acids called scum.



- **Advantages of synthetic detergents over soaps** :
  - They can be used in hard water, in acidic medium while soaps get precipitated.
  - They are more soluble in water and thus form lather more easily.
  - They are stronger cleansing agents than soaps as they decrease the surface tension to greater extent.

### ✓ PEEP INTO PREVIOUS YEARS

11. The liquified gas that is used in dry cleaning along with a suitable detergent is
- (a) water gas (b) petroleum gas  
(c)  $\text{NO}_2$  (d)  $\text{CO}_2$
- (Odisha NEET 2019)

12. Which of the following is an anionic detergent?

- (a) Sodium stearate  
(b) Sodium lauryl sulphate  
(c) Cetyltrimethylammonium bromide  
(d) Glyceryl oleate
- (JEE Main 2016)

### 🔑 POINTS FOR EXTRA SCORING

- Ibuprofen is a chiral drug. Only its (S)-isomer is effective but (R)-isomer has no anti-inflammatory action. However, the (R)-isomer is slowly converted into the (S)-isomer in the body but the (S)-isomer alone acts much more quickly than the racemate.
- **Uses of sulpha drugs :**
  - Sulphapyridine : used to cure pneumonia.
  - Sulphadiazine : used to cure pneumonia, throat infection, meningitis, etc.
  - Sulphaguanidine : used to cure bacillary dysentery.
  - Sulphathiazole : useful against staphylococcal infections and bubonic plague.
  - Succinyl sulphathiazole : useful in intestinal infections such as bacillary dysentery and cholera.
  - Sulpha acetamide : used to cure urinary tract infections.
- Ranitidine and cimetidine are used in the treatment of peptic ulcers.
- Pantoprazole and omeprazole are the new drugs used to inhibit gastric secretion.
- In addition to sugar and salt the substances such as vinegar, oils, spices and citric acid are also used to preserve jam, pickles, ketchups and squashes, etc.
- Highly branched sodium alkylbenzene-sulphonates are non-biodegradable.

### Answer Key For Peep Into Previous Years

- |    |     |    |     |    |     |     |        |     |     |     |     |
|----|-----|----|-----|----|-----|-----|--------|-----|-----|-----|-----|
| 1. | (d) | 2. | (d) | 3. | (c) | 4.  | (a, c) | 5.  | (b) | 6.  | (d) |
| 7. | (b) | 8. | (b) | 9. | (c) | 10. | (c)    | 11. | (d) | 12. | (b) |





# WRAP it up!

1. Which of the following polymers do not involve cross linkages?

- (a) Melmac (b) Bakelite  
(c) Teflon (d) Vulcanised rubber

2. Which one of the following is an antimalarial drug?

- (a) Phenol (b) DDT  
(c) Paludrine (d) DDE

3. The catalyst used for olefin polymerisation is

- (a) Ziegler-Natta catalyst  
(b) Wilkinson catalyst  
(c) Raney nickel catalyst  
(d) Merrifield resin.

4. Match Column I (Monomer) with column II (Polymer) and select the correct option.

| Column I |                                     | Column II |            |
|----------|-------------------------------------|-----------|------------|
| I.       | Hexamethylenediamine + Adipic acid  | A.        | Bakelite   |
| II.      | Phenol + Formaldehyde               | B.        | Dacron     |
| III.     | Phthalic acid + Ethylene glycol     | C.        | Glyptal    |
| IV.      | Terephthalic acid + Ethylene glycol | D.        | Nylon 6, 6 |

- (a) I-D, II-A, III-B, IV-C  
(b) I-D, II-A, III-C, IV-B  
(c) I-D, II-C, III-A, IV-B  
(d) I-D, II-B, III-A, IV-C

5. Which of the following is an incorrect statement?

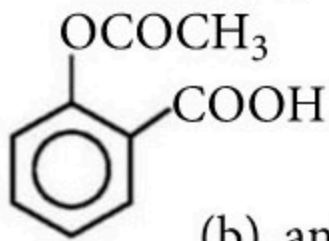
- (a) Non-ionic detergents are neutral.  
(b) The hydrophilic portion of a non-ionic detergent functions by a hydrogen bonding mechanism.  
(c) Cationic detergents have a positively charged water soluble portion.  
(d) LABs detergent are non-biodegradable.

6. The monomers of Buna-S rubber are

- (a) styrene and 1, 3-butadiene  
(b) isoprene and 1, 3-butadiene  
(c) vinyl chloride and sulphur  
(d) butadiene and acrylonitrile.

7. Soft drinks and baby feeding bottles are generally made up of

- (a) polystyrene (b) polyurethane  
(c) polyurea (d) polyamide.

8. The compound,  is used as a

- (a) antiseptic (b) antibiotic  
(c) analgesic (d) pesticide.

9. Monomer of  $\left[ \begin{array}{c} \text{CH}_3 \\ | \\ \text{C} - \text{CH}_2 \\ | \\ \text{CH}_3 \end{array} \right]_n$  is

- (a) 2-methylpropene (b) styrene  
(c) propylene (d) ethene.

10. Which of the following statements is not correct?

- (a) Soaps act by lowering surface tension between water and oil/insoluble material.  
(b) The soap form insoluble salt with  $\text{Ca}^{2+}$  ions.  
(c) The  $\text{COO}^-$  group in soaps acts as hydrophilic and alkyl chain as hydrophobic.  
(d) Soaps work more efficiently in hard water than in soft water.

11. The turbidity of a polymer solution measures

- (a) the light scattered by solution  
(b) the light absorbed by a solution  
(c) the light transmitted by a solution  
(d) none of these.

12. Nylon is classified as a condensation polymer because

- (a) in its preparation a solid is formed from liquid monomers  
(b) its structure contains the peptide linkage ( $-\text{CONH}-$ ).  
(c) it can be prepared from aqueous solutions of its monomers.

## Monthly Test Drive CLASS XII

## ANSWER KEY

1. (a) 2. (a) 3. (a) 4. (c) 5. (d)  
6. (b) 7. (a) 8. (d) 9. (c) 10. (c)  
11. (c) 12. (d) 13. (c) 14. (a) 15. (a)  
16. (b) 17. (b) 18. (b) 19. (d) 20. (a,b,c)  
21. (b,c,d) 22. (a,b,d) 23. (a,c,d) 24. (2) 25. (5)  
26. (5) 27. (d) 28. (a) 29. (a) 30. (c)



(d) a small molecule is eliminated in its formation from its monomers.

13. A broad spectrum antibiotic is  
 (a) paracetamol (b) penicillin-G  
 (c) aspirin (d) chloramphenicol.
14. The drug given during hypertension is  
 (a) streptomycin (b) chloroxylenol  
 (c) equanil (d) aspirin.
15. The condensation polymer among the following is  
 (a) protein (b) PVC  
 (c) polythene (d) rubber.
16. Which one of the following is not an example of chain growth polymer?  
 (a) Neoprene (b) Buna-S  
 (c) PMMA (d) Glyptal
17. Which of the following statements is true for detergents?  
 (a) ABS is a anionic detergent.  
 (b) Cetyltrimethylammonium bromide is a cationic detergent.  
 (c) Polyethylene glycol stearate is a non-ionic detergent.  
 (d) All of these.
18. The structural formula of monomer of poly methylmethacrylate (PMMA) is  
 (a)  $\text{CH}_2=\text{CHCOOCH}_3$  (b)  $\text{CH}_2=\overset{\text{CH}_3}{\underset{|}{\text{C}}}-\text{COOCH}_3$   
 (c)  $\text{CH}_3\text{COOCH}=\text{CH}_2$  (d)  $\text{CH}_3\text{COOC}=\overset{\text{CH}_3}{\underset{|}{\text{C}}}\text{H}_2$
19. The amount of alkali necessary to convert an oil or fat into soap is known by its  
 (a) iodine value (b) Reichert Meissl value  
 (c) saponification value (d) acid value.
20. Di-(*n*-butyl) phthalate is a  
 (a) plasticizer (b) thermoplastic  
 (c) polymer (d) thermosetting plastic.

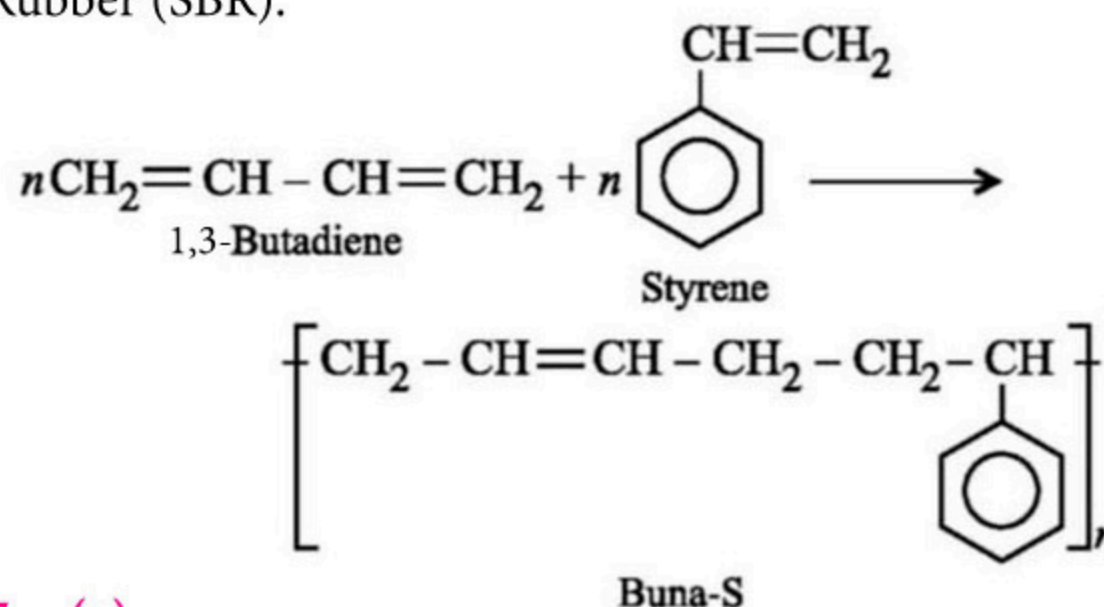
### SOLUTIONS

1. (c):  $n\text{F}_2\text{C}=\text{CF}_2 \xrightarrow[\text{High pressure}]{(\text{NH}_4)_2\text{S}_2\text{O}_8} (\text{F}_2\text{C}-\text{CF}_2)_n$   
 Tetrafluoroethene Teflon
2. (c): Paludrine tablets contain the active ingredient proguanil hydrochloride, which is an antimalarial medicine.
3. (a): Ziegler-Natta catalyst  $[(\text{C}_2\text{H}_5)_3\text{Al} + \text{TiCl}_4]$  is used in linear polymerisation to prepare high density polyethylene (HDPE).

4. (b)

5. (d)

6. (a): Buna - S is also known as Styrene-Butadiene Rubber (SBR).



7. (a)

8. (c): Aspirin or acetylsalicylic acid or 2-acetoxybenzoic acid is an analgesic as well as antipyretic.

9. (a): Formula of the monomer indicated in bracket,  $(\text{CH}_3)_2\text{C}=\text{CH}_2$ , corresponds to 2-methylpropene.

10. (d): The incorrect statement is, "soaps work more efficiently in hard water than in soft water. Soaps actually do not give foams in hard water due to formation of insoluble salts like calcium stearate and magnesium stearate. As hard water contain carbonates and bicarbonates of Ca and Mg.

11. (a): When light passes through a polymer solution it scatters and turbidity of a polymer solution measures light scattered by the solution.

12. (d): Nylon is a condensation polymer because in the reaction of adipic acid with hexamethylenediamine, small molecule like  $\text{H}_2\text{O}$  is eliminated in its formation.

13. (d)

14. (c): Equanil is used in controlling depression and hypertension.

15. (a): Condensation polymers are formed by the combination of monomers with the elimination of simple molecules like water or alcohol, e.g., polyesters and polyamides. Thus, out of the given options, proteins are condensation polymers of amino acids.

16. (d): Glyptal is an example of a step growth polymer.

17. (d): All statements are true.

18. (b): The monomer of PMMA is methyl methacrylate i.e.,  $\text{CH}_2=\overset{\text{CH}_3}{\underset{|}{\text{C}}}-\text{COOCH}_3$ .

19. (c)

20. (a): Di-(*n*-butyl) phthalate is a plasticizer, added to PVC to make it soft.







# CBSE warm-up!

Exam on  
7<sup>th</sup> March  
2020

CLASS-XII

Practice questions for CBSE Exams as per the latest pattern  
and marking scheme issued by CBSE for the academic session 2019-20.

## Practice Paper 2020

Time Allowed : 3 hours  
Maximum Marks : 70

### GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
- Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
- Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
- Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

### SECTION - A

Read the given passage and answer the questions 1 to 5 that follow :

For the reaction,  $2\text{NO}_{(g)} + \text{Cl}_{2(g)} \longrightarrow 2\text{NOCl}_{(g)}$   
the following data were collected. All the measurements were taken at 263 K.

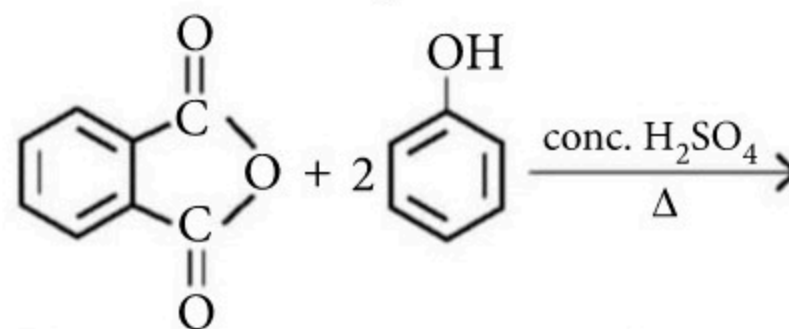
| Exp. No. | Initial [NO] (M) | Initial [Cl <sub>2</sub> ] (M) | Initial rate of disapp. of Cl <sub>2</sub> (M/min) |
|----------|------------------|--------------------------------|--|
| 1.       | 0.15             | 0.15                           | 0.60   |
| 2.       | 0.15             | 0.30                           | 1.20   |
| 3.       | 0.30             | 0.15                           | 2.40   |
| 4.       | 0.25             | 0.25                           | ?  |

- Write the expression for rate law?
- What is the order of the reaction?
- What is the molecularity of the reaction?
- Calculate the value of rate constant and specify its units.

- What is the initial rate of disappearance of Cl<sub>2</sub> in exp. no. 4?

Questions 6 to 10 are one word answers :

- Name a drug used in case of mental depression.
- Give the IUPAC name of  $[\text{Co}(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3$ .
- Name the method used for the refining of titanium metal.
- Give the name of product of the following reaction :

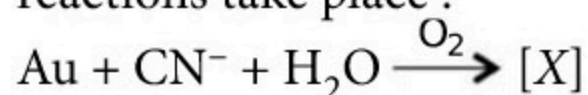


- Name the polymer used in making non-stick kitchenwares.



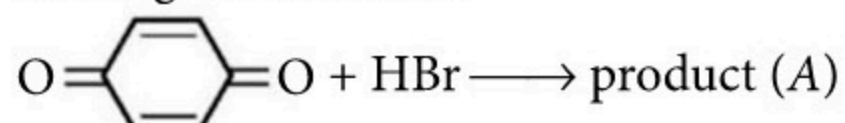
**Questions 11 to 15 are multiple choice questions :**

11. During the extraction of gold the following reactions take place :

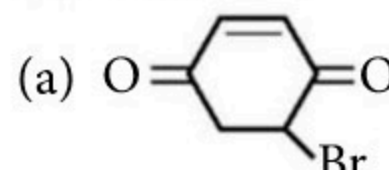
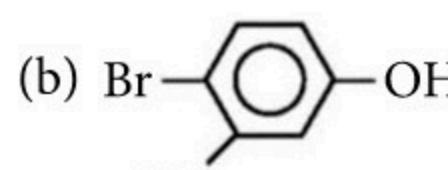
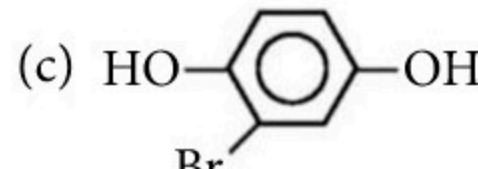
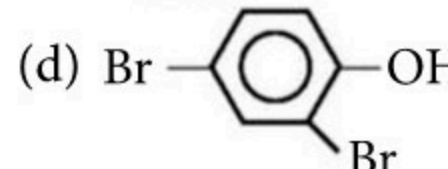


X and Y are respectively

- (a)  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{CN})_6]^{4-}$   
 (b)  $[\text{Au}(\text{CN})_4]^{2-}$  and  $[\text{Zn}(\text{CN})_4]^{2-}$   
 (c)  $[\text{Au}(\text{CN})_4]^{3-}$  and  $[\text{Zn}(\text{CN})_4]^{2-}$   
 (d)  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{CN})_4]^{2-}$
12. A greenish yellow gas (X) reacts with hot and conc. alkali metal hydroxide to form a halate (Y) which can be used in fireworks and safety matches. The gas (X) and the halate (Y) are  
 (a)  $\text{Br}_2$  and  $\text{KBrO}_3$  (b)  $\text{Cl}_2$  and  $\text{KClO}_3$   
 (c)  $\text{I}_2$  and  $\text{NaIO}_3$  (d)  $\text{I}_2$  and  $\text{KIO}_3$
13. Some drugs interact with enzymes and make them biologically inactive. Such drugs are called  
 (a) enzyme promoters (b) enzyme inhibitors  
 (c) allogeins (d) all of these.
14. Which one of the following monomers form biodegradable polymer?  
 (a) Urea and formaldehyde  
 (b) Ethylene glycol and terephthalic acid  
 (c) 3-Hydroxybutanoic acid and 3-hydroxypentanoic acid  
 (d) Phenol and caproic acid
15. In the given reaction,



(A) would be

- (a)  (b)   
 (c)  (d) 

**Questions 16 to 20 :**

- (a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.  
 (b) Both assertion and reason are correct statements but reason is not the correct explanation of the assertion.  
 (c) Assertion is correct, but reason is wrong statement.  
 (d) Assertion is wrong, but reason is correct statement.
16. **Assertion :** Sodium 4-(2-dodecyl) benzene sulphonate is a biodegradable detergent.  
**Reason :** Detergents having highly branched chains are biodegradable.

17. **Assertion :** Electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

**Reason :** Halogens are *ortho* and *para*-directors.

18. **Assertion :** Aromatic aldehydes and formaldehydes undergo Cannizzaro reaction.

**Reason :** Those aldehydes which have  $\alpha$ -H atom undergo Cannizzaro reaction.

19. **Assertion :** Froth floatation process is based on the different wetting nature of ore and gangue particles.

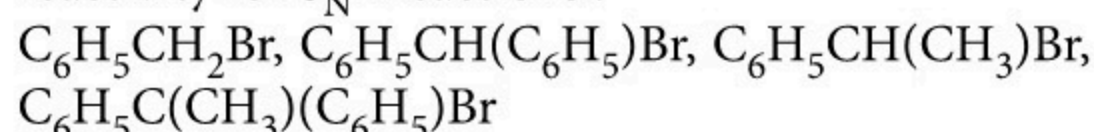
**Reason :** Mustard oil is used as frother in froth floatation process.

20. **Assertion :** *Ortho* and *para*-nitrophenol can be separated by steam distillation.

**Reason :** *Para*-nitrophenol is steam volatile due to intramolecular hydrogen bonding.

**SECTION - B**

21. (i) Arrange the following in the increasing reactivity for  $\text{S}_{\text{N}}1$  reactions :



(ii) Alkyl halides, though polar, are immiscible with water, why ?

22. Explain the following :

(i) Low spin octahedral complexes of nickel are not known.

$$(ii) \Delta_t = \frac{4}{9} \Delta_o$$

**OR**

Using valence bond theory of complexes, explain the geometry and magnetic nature of  $[\text{Ni}(\text{CN})_4]^{2-}$ . (At. no. of Ni = 28)

23. Calculate  $\Delta_r G^\circ$  and  $\log K_c$  for the following reaction :



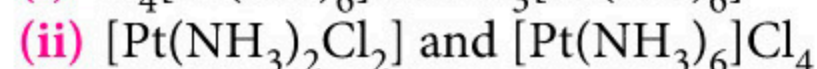
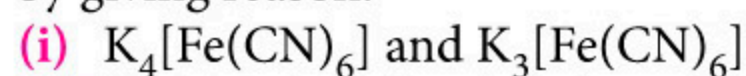
[Given :  $E^\circ_{\text{Cd}^{2+}/\text{Cd}} = -0.403 \text{ V}$  ;  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.763 \text{ V}$ ]

24. Calculate the osmotic pressure at  $17^\circ\text{C}$  of an aqueous solution containing 1.75 g of sucrose per 150 mL solution.

**OR**

The osmotic pressure of a non-volatile solute in  $\text{C}_6\text{H}_6$  at  $25^\circ\text{C}$  is  $20.66 \text{ Nm}^{-2}$ . If the solution had a concentration of  $2 \text{ g/dm}^3$ , what is the molecular weight of solute?

25. Which of the following complexes (in solution) will have greater value of molar conductivity? Explain by giving reason.

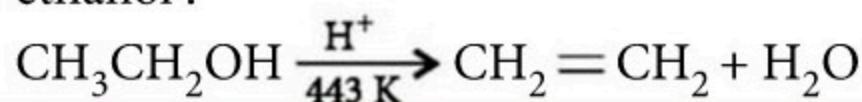




26. (i)  $\text{Cu}^{2+}$  salts are coloured while  $\text{Zn}^{2+}$  salts are white. Why?

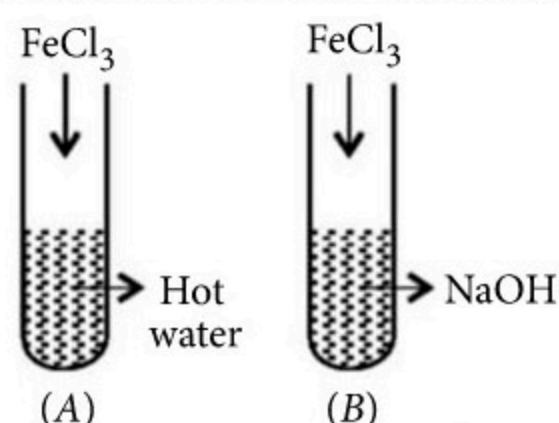
(ii)  $[\text{CuCl}_4]^{2-}$  exists but  $[\text{CuI}_4]^{2-}$  does not. Why?

27. Explain the mechanism of dehydration steps of ethanol :



### SECTION - C

28. (i) A colloidal solution of ferric oxide is prepared by two different methods as shown below:



(a) What is the charge on colloidal particles in two test tubes (A) and (B)?

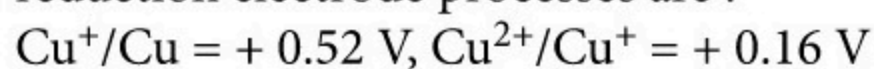
(b) Give reasons for the origin of charge.

(ii) What is 'occlusion'?

OR

In an adsorption experiment, a graph between  $\log (x/m)$  versus  $\log P$  was found to be linear with a slope of  $45^\circ$ . The intercept on the  $\log (x/m)$  axis was found to be 0.3010. Calculate the amount of the gas adsorbed per gram of charcoal under a pressure of 0.5 atm.

29. The  $E^\circ$  values corresponding to the following two reduction electrode processes are :



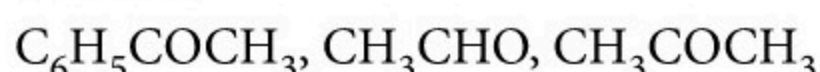
Formulate the galvanic cell for their combination. What will be the standard cell potential for it? Calculate  $\Delta_r G^\circ$  for the cell reaction.

$$[F = 96500\text{ C mol}^{-1}]$$

30. What is lanthanoid contraction? What is its effect on the chemistry of the elements which follow the lanthanoids?

31. (i) Write the chemical reaction involved in Wolff-Kishner reduction.

(ii) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction.



(iii) A and B are two functional isomers of compound  $\text{C}_3\text{H}_6\text{O}$ . On heating with  $\text{NaOH}$  and  $\text{I}_2$ , isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B.

OR

An organic compound (A) which has characteristic odour, on treatment with  $\text{NaOH}$  forms two compounds (B) and (C). Compound (B) has the molecular formula,  $\text{C}_7\text{H}_8\text{O}$  which on oxidation with  $\text{CrO}_3$  gives back compound (A). Compound (C) is the sodium salt of the acid. Compound (C) when heated with soda lime yields an aromatic hydrocarbon (D). Deduce the structures of (A), (B), (C) and (D). Write chemical equations for all reactions taking place.

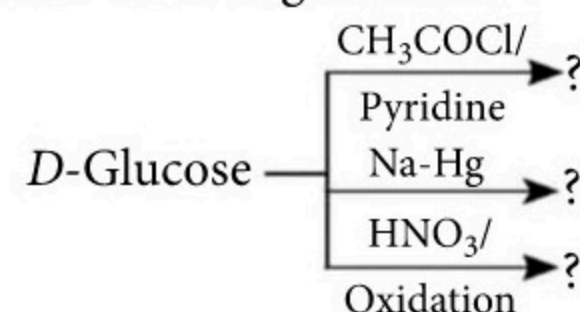
32. Explain why

(i) 4%  $\text{NaOH}$  solution (mass/volume) and 6% urea solution (mass/volume) are equimolar but not isotonic.

(ii) Aquatic species feel more comfortable in winter than in summer.

(iii) A solution of chloroform and acetone shows negative deviation from Raoult's law.

33. Complete the following reactions :



34. How will you obtain

(i) propanoic acid from ethyne

(ii) 2-methylbutanoic acid from butan-2-ol?

### SECTION - D

35. (a) Give one chemical test to distinguish between the compounds of the following pairs :

(i)  $\text{CH}_3\text{NH}_2$  and  $(\text{CH}_3)_2\text{NH}$

(ii) Aniline and ethanamine

(b) Why aniline does not undergo Friedel-Crafts reaction?

(c) Write the chemical equation involved in the following reaction :

Hofmann bromamide degradation reaction

(d) Arrange the following in increasing order of basic strength :



OR

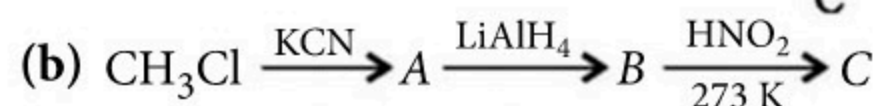
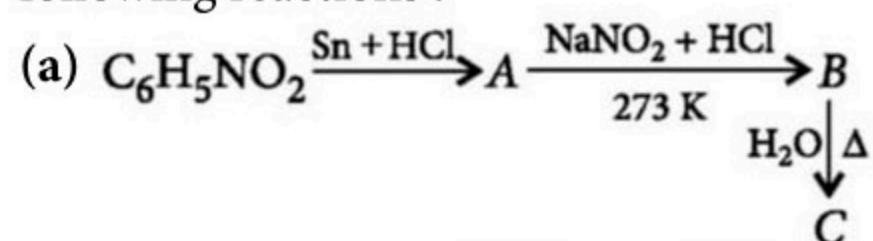
(i) Write the structures of main products when benzenediazonium chloride ( $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$ ) reacts with the following reagents :

(a)  $\text{HBF}_4/\Delta$

(b)  $\text{Cu/HBr}$



- (ii) Write the structures of A, B and C in the following reactions :



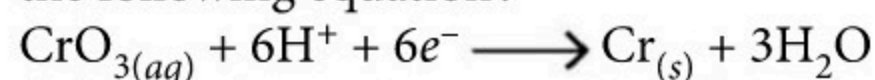
36. (i) State reasons for the following :

- (a) Rusting of iron is said to be an electrochemical phenomenon.  
(b) For a weak electrolyte, its molar conductance in dilute solutions increases sharply as its concentration in solution is decreased.

- (ii) Equivalent conductance of a 0.0128 N solution of acetic acid is  $1.4 \text{ mho cm}^2 \text{ eq}^{-1}$  and conductance at infinite dilution is  $391 \text{ mho cm}^2 \text{ eq}^{-1}$ . Calculate degree of dissociation and dissociation constant of acetic acid.

OR

- (i) Chromium metal is electroplated using an acidic solution containing  $\text{CrO}_3$  according to the following equation:



Calculate how many grams of chromium will be electroplated by 24,000 coulombs. How long will it take to electroplate 1.5 g chromium using 12.5 A current?

[Atomic mass of Cr =  $52 \text{ g mol}^{-1}$ ,  
 $1 \text{ F} = 96500 \text{ C mol}^{-1}$ ]

- (ii) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is  $1500 \Omega$ . What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is  $0.146 \times 10^{-3} \text{ S cm}^{-1}$ ?

37. (i) What happens when

- (a) Concentrated  $\text{H}_2\text{SO}_4$  is added to calcium fluoride.  
(b)  $\text{SO}_3$  is passed through water?

- (ii) Give at least one example to explain the following properties

- (a) Sulphuric acid is a dibasic acid.  
(b) Sulphuric acid is a dehydrating agent.  
(c) Sulphuric acid is an oxidising agent.

OR

- (i) Give reasons :

$\text{H}_3\text{PO}_3$  undergoes disproportionation reaction but  $\text{H}_3\text{PO}_4$  does not.

- (ii) Describe the following :

- (a) Relative oxidising power of halogens.  
(b) Relative acidic strength of the hydrogen halides.

- (iii) Explain the following :

- (a) Xenon does not form such fluorides as  $\text{XeF}_3$  and  $\text{XeF}_5$ .  
(b) Out of noble gases, only xenon is known to form real chemical compounds.

## SOLUTIONS

1. Let rate of this reaction  $r = k[\text{NO}]^m[\text{Cl}_2]^n$

$$\text{then } \frac{r_1}{r_2} = \frac{0.60}{1.20} = \frac{k(0.15)^m(0.15)^n}{k(0.15)^m(0.30)^n}$$

$$\text{or } \frac{1}{2} = \left(\frac{1}{2}\right)^n \Rightarrow n = 1$$

$$\text{Again from } \frac{r_2}{r_3} = \frac{1.20}{2.40} = \frac{k(0.15)^m(0.30)^1}{k(0.30)^m(0.15)^1}$$

$$\text{or } \frac{1}{2} = \left(\frac{1}{2}\right)^m \cdot \frac{2}{1} \quad \text{or } \frac{1}{4} = \left(\frac{1}{2}\right)^m \Rightarrow m = 2$$

Hence, expression for rate law is,  $r = k[\text{NO}]^2[\text{Cl}_2]$

2. The order of the reaction =  $2 + 1 = 3$

3. The molecularity of the reaction = 3

4. Substituting the values in experiment (1),

$$0.60 \text{ M min}^{-1} = k(0.15 \text{ M})^2 (0.15 \text{ M})$$

$$k = \frac{0.60 \text{ M min}^{-1}}{0.0225 \times 0.15 \text{ M}^3} = 177.8 \text{ M}^{-2} \text{ min}^{-1}$$

5. In experiment no. (4),

$$r = 177.8 \text{ M}^{-2} \text{ min}^{-1} \times (0.25 \text{ M})^2 (0.25 \text{ M}) = 2.79 \text{ M min}^{-1}$$

6. Equanil

7. *Tris*-(ethane-1,2-diammine) cobalt (III) sulphate

8. van Arkel method 9. Phenolphthalein

10. Teflon 11. (d) 12. (b)

13. (b) 14. (c) 15. (c)

16. (c) : Detergents with long straight chains (unbranched chains) are biodegradable.

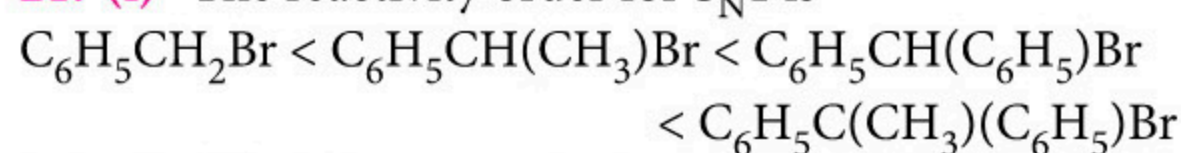
17. (b)

18. (c) : Aldehydes with no  $\alpha$ -hydrogen atoms, undergo Cannizzaro reaction.

19. (c) : Pine oil is used as frother which wets ore particles whereas gangue particles are wetted by water.

20. (c)

21. (i) The reactivity order for  $\text{S}_{\text{N}}1$  is



- (ii) Alkyl halides are polar but are insoluble in water because energy required to break the intermolecular H-bonding among water molecules is much higher than energy released by water halide interaction.



22. (i) For low spin, electrons should be pair up. Nickel forms octahedral complexes mainly in +2 oxidation state which has  $3d^8$  configuration. In presence of strong field ligand also it has two unpaired electrons in  $e_g$  orbital.

Hence, it does not form low spin octahedral complexes.

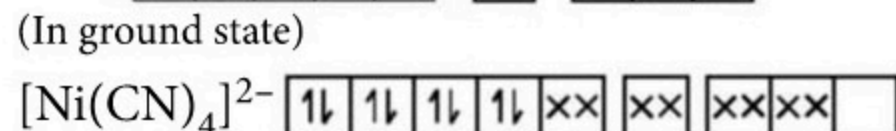
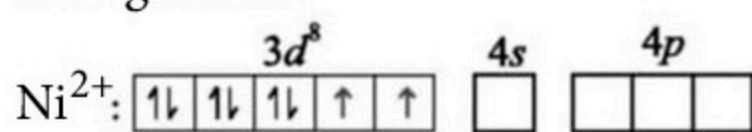
(ii) Number of ligands in tetrahedral geometry is 4 whereas in octahedral geometry it is 6.

In tetrahedral geometry, no orbital lies directly in the path of ligand whereas in octahedral geometry axial orbitals interact directly with the ligand.

This is why  $\Delta_t = \frac{4}{9} \Delta_o$ .

OR

In  $[\text{Ni}(\text{CN})_4]^{2-}$ : Ni is present as Ni(II) with  $3d^8$  configuration.



$dsp^2$  hybridisation four electron pairs  
donated by four  $\text{CN}^-$  ions ( $\text{CN}^-$  is strong ligand)

The complex ion has square planar geometry and is diamagnetic in nature.

23.  $E_{\text{cell}}^\circ = E_{\text{right}}^\circ - E_{\text{left}}^\circ = -0.403 - (-0.763) = 0.36 \text{ V}$

$\Delta_r G^\circ = -nFE_{\text{cell}}^\circ = -2 \times 96500 \times 0.36$   
 $= -69480 \text{ J} = -69.48 \text{ kJ}$

Using formula,  $\log K_c = \frac{nE_{\text{cell}}^\circ}{0.0591} = \frac{2 \times 0.36}{0.0591} = 12.18$

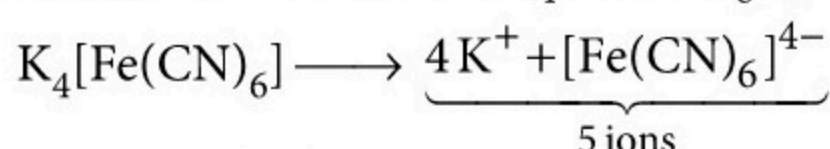
$K_c = \text{antilog } 12.18 = 1.51 \times 10^{12}$

24.  $\pi V = nRT = \frac{w}{m} RT$ ;  $\pi \times \frac{150}{1000} = \frac{1.75}{342} \times 0.0821 \times 290$   
 $\pi = 0.812 \text{ atm}$

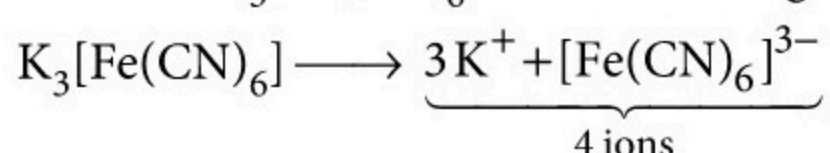
OR

$\pi V = \frac{w}{m} RT$   $\therefore m = \frac{w}{V \pi} RT$   
 $m = \frac{2 \times 10^{-3} \times 8.314 \times 298}{10^{-3} \times 20.66} = 239.84 \text{ kg mol}^{-1}$

25. (i) On ionisation,  $\text{K}_4[\text{Fe}(\text{CN})_6]$  gives 5 ions.



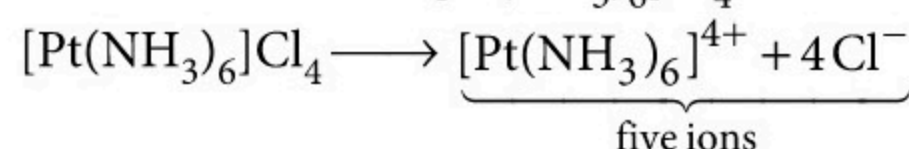
Whereas  $\text{K}_3[\text{Fe}(\text{CN})_6]$  on ionisation gives 4 ions.



Since,  $\text{K}_4[\text{Fe}(\text{CN})_6]$  gives more number of ions (i.e., five ions) as compared to  $\text{K}_3[\text{Fe}(\text{CN})_6]$  (i.e., four ions), on

ionisation,  $\text{K}_4[\text{Fe}(\text{CN})_6]$  will have greater value of molar conductivity.

(ii)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  is a non-electrolyte, it does not ionise in solution whereas  $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$  ionises to give 5 ions.



Hence,  $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$  will have greater molar conductivity as compared to  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ .

26. (i)  $\text{Zn}^{2+}$  ion has completely filled  $d$ -subshell and no  $d-d$  transition is possible. So, zinc salts are white. Configuration of  $\text{Cu}^{2+}$  is  $[\text{Ar}] 3d^9$ . It has partly filled  $d$ -subshell and hence, it is coloured due to  $d-d$  transition.

(ii)  $\text{I}^-$  ion is a stronger reducing agent than  $\text{Cl}^-$  ion, therefore  $\text{I}^-$  ion reduces  $\text{Cu}^{2+}$  to  $\text{Cu}^+$  ion. As a result  $\text{CuI}_2$  is converted into  $\text{CuI}$  and hence  $[\text{CuI}_4]^{2-}$  does not exist.

27. Refer to answer 36, Page no. 185 (MTG CBSE Champion Chemistry Class 12).

28. (i) (a) Colloidal particles of test tube (A) are positively charged whereas colloidal particles of test tube (B) are negatively charged.

(b) In test tube (A),  $\text{Fe}^{3+}$  ions are adsorbed on the ppt. of  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$  or  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}/\text{Fe}^{3+}$  is formed.

In test tube (B),  $\text{OH}^-$  ions are adsorbed on the ppt. of  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$  or  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}/\text{OH}^-$  is formed.

(ii) The adsorption of gases on the surface of metals is called occlusion.

OR

According to the Freundlich equation,

$\frac{x}{m} = kP^{1/n}$  or  $\log \frac{x}{m} = \log k + \frac{1}{n} \log P$

$\therefore$  Plot of  $\log x/m$  versus  $\log P$  is linear with slope =  $1/n$  and intercept =  $\log k$ . Thus,  $1/n = \tan 45^\circ = 1 \Rightarrow n = 1$

$\log k = 0.3010$  or  $k = \text{antilog } 0.3010 = 2$

At  $P = 0.5 \text{ atm}$ ,  $x/m = kP^{1/n} = 2 \times (0.5)^1 = 1.0 \text{ g}$

29. At cathode:  $\text{Cu}^+ + e^- \longrightarrow \text{Cu}$ ,  $E^\circ = +0.52 \text{ V}$

At anode:  $\text{Cu}^+ \longrightarrow \text{Cu}^{2+} + e^-$ ,  $E^\circ = +0.16 \text{ V}$

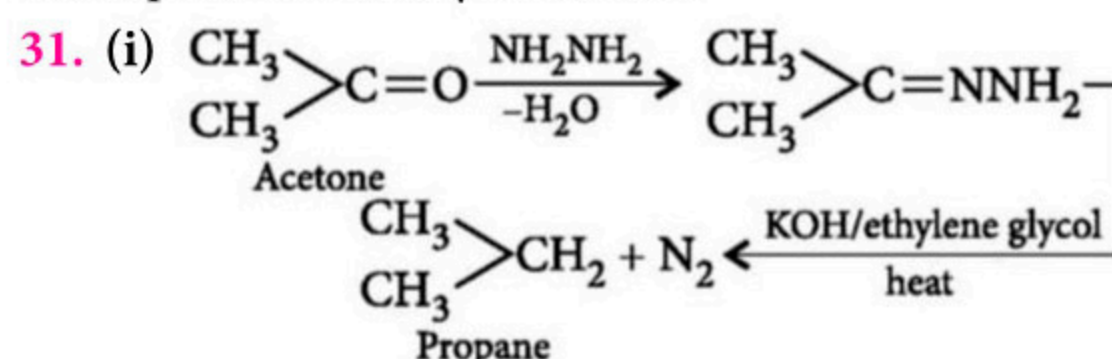
Cell reaction:  $2\text{Cu}^+ \longrightarrow \text{Cu} + \text{Cu}^{2+}$

Cell representation is  $\text{Cu}^+ | \text{Cu}^{2+} || \text{Cu}^+ | \text{Cu}$

$E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ = 0.52 - 0.16 = 0.36 \text{ V}$

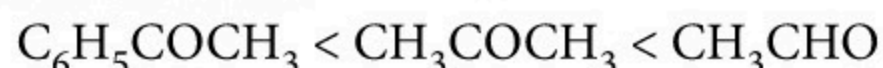
$\Delta_r G^\circ = -nE^\circ F = -1 \times 0.36 \times 96500 = -34740 \text{ J mol}^{-1}$

30. Refer to answer 110, Page no. 131 (MTG CBSE Champion Chemistry Class 12).





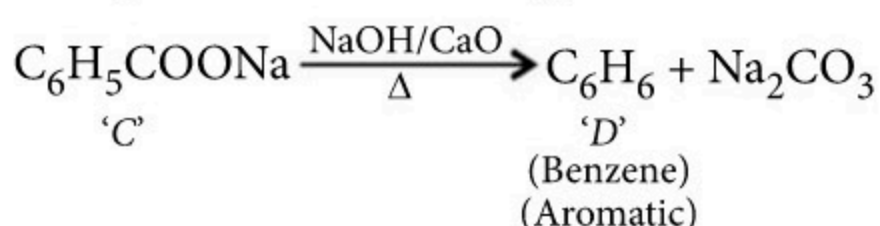
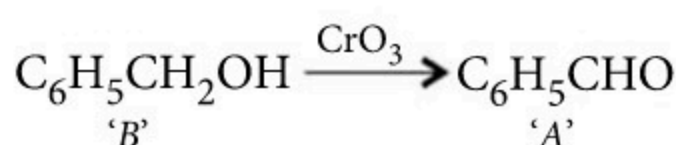
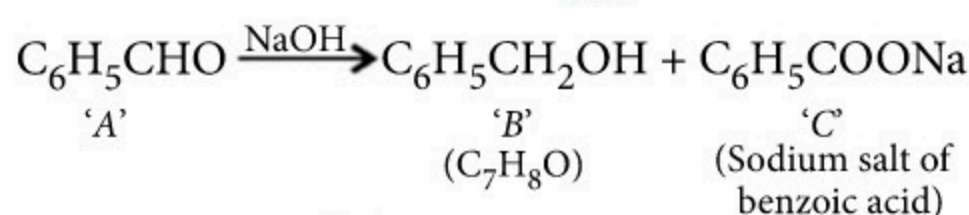
(ii) Increasing order of reactivity towards nucleophilic addition reaction :



(c) Formula of compounds A and B is  $C_3H_6O$ , B forms yellow precipitate of iodoform. Hence, B must contain  $-COCH_3$  group. Therefore, compound 'B' must be  $CH_3COCH_3$ .

A does not give iodoform test and it is functional isomer of B thus, it may be  $CH_3CH_2CHO$ .

OR

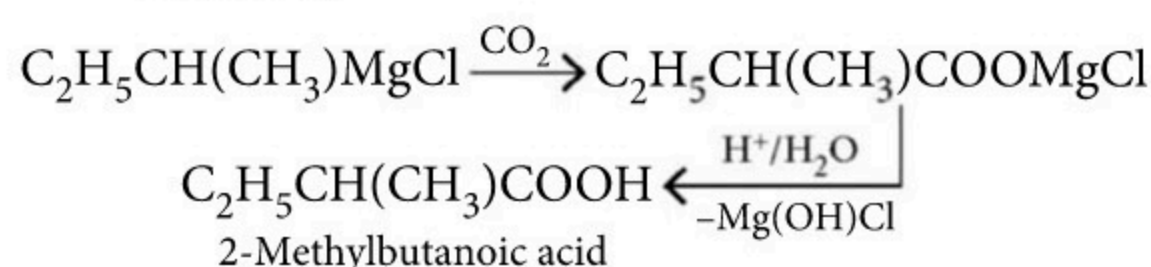
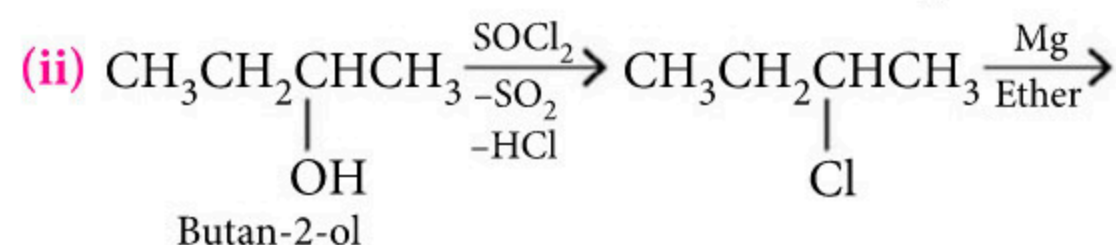
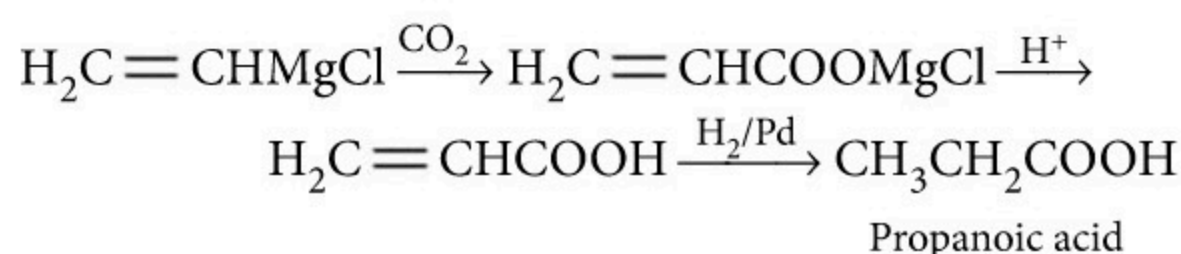
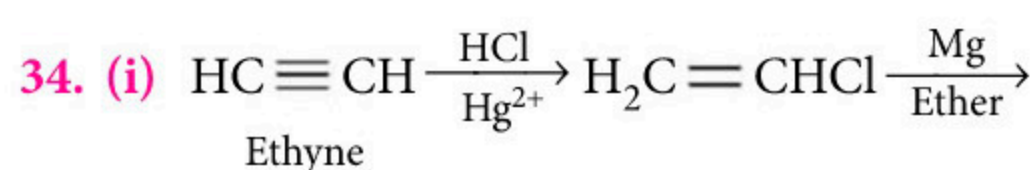
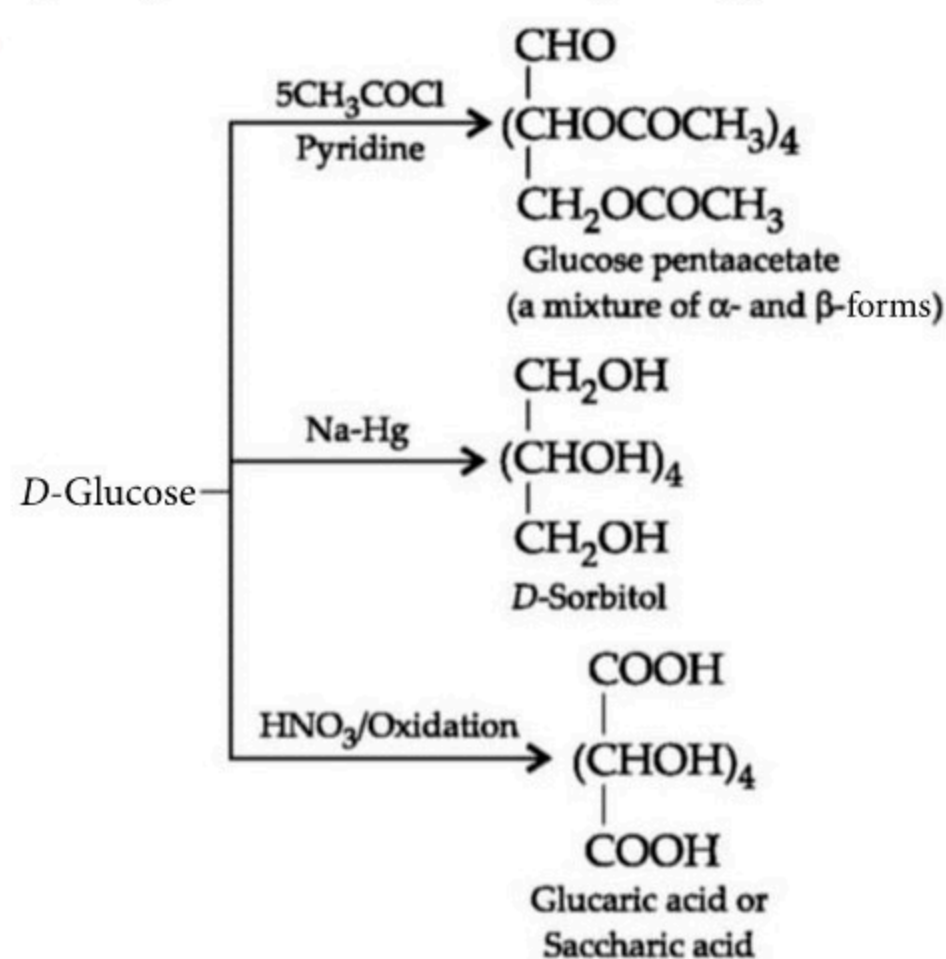


32. (i) Both the solutions 4% NaOH (m/V) and 6% urea (m/V) have same concentration (1 M) but these are not isotonic because NaOH undergoes dissociation in solution but urea does not. Therefore, number of particles in NaOH solution is more than that in urea solution.

(ii) In winter season at low temperature, solubility of oxygen in water is higher than that in summer at high temperature. Hence, aquatic species feel more comfortable in winter than in summer.

(iii) A mixture of chloroform and acetone shows negative deviation from Raoult's law because chloroform molecule forms H-bonding with acetone molecule. As a result of this, A—B interaction becomes stronger than A—A and B—B interactions. This leads to the decrease in vapour pressure and resulting in negative deviation.

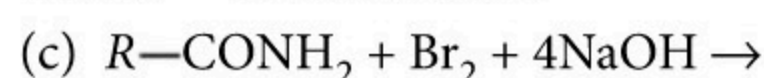
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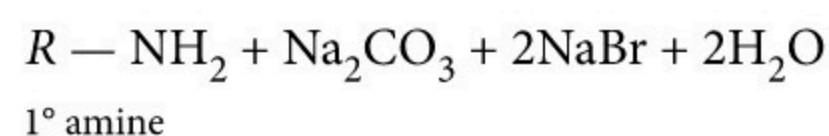
35. (a) (i) : Methylamine gives carbylamine test, i.e., on treatment with *alc.* KOH and chloroform, followed by heating it gives offensive odour of methyl isocyanide. Dimethylamine does not give this test.

(ii) Aniline being an aromatic primary amine on treatment with  $HNO_2$  at 273–278 K followed by treatment with an alkaline solution of  $\beta$ -naphthol gives an orange coloured azo dye. Ethylamine does not give this test.

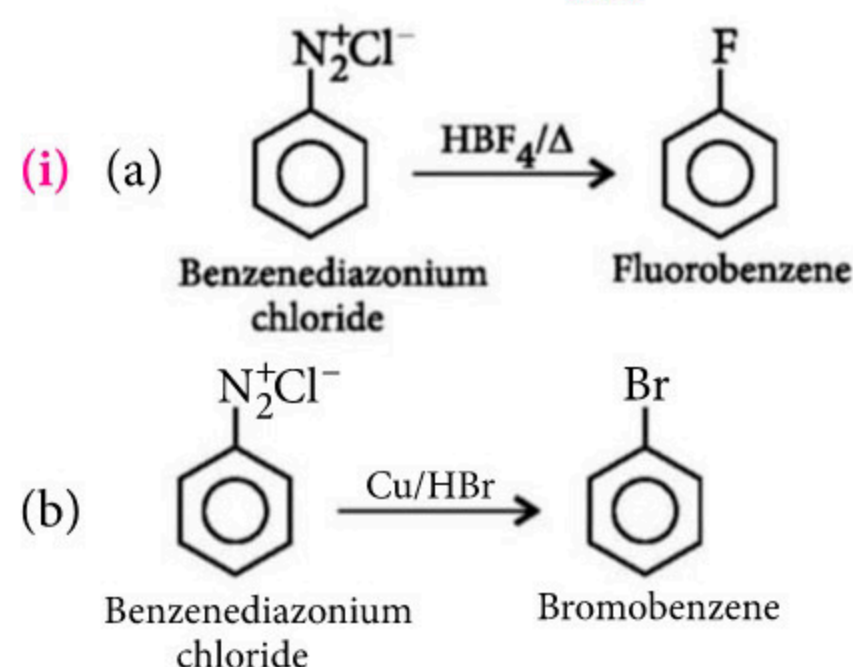
(b) In Friedel-Crafts reaction,  $AlCl_3$  is added as a catalyst which is a Lewis acid. It forms a salt with aniline due to which the nitrogen of aniline acquires positive charge. This positively charged nitrogen acts as a strong deactivating group, hence aniline does not undergo Friedel — Crafts reaction.



Acid amide



OR



(ii) (a) Refer to answer 50 (i), Page no. 229 (MTG CBSE Champion Chemistry Class 12).



(b) Refer to answer 66 (ii), Page no. 231 (MTG CBSE Champion Chemistry Class 12).

**36. (i)** (a) According to electrochemical theory during the formation of rust the impure iron surface behaves like a small electrochemical cell. In such cells pure iron acts as anode and impure surface acts as cathode. Moisture containing dissolved  $O_2$  or  $CO_2$  is the electrolytic solution. Hence, rusting is an electrochemical phenomenon.

(b) On dilution, the degree of ionisation of the weak electrolyte increases. This increases the molar conductance of the solution sharply.

**(ii)** Given :  $\Lambda_{eq} = 1.4 \text{ mho cm}^2 \text{ eq}^{-1}$ ,

$\Lambda_{eq}^\circ = 391 \text{ mho cm}^2 \text{ eq}^{-1}$ ,  $\alpha = ?$   $K_a = ?$

$$\text{Using formula, } \alpha = \frac{\Lambda_{eq}}{\Lambda_{eq}^\circ} = \frac{1.4 \text{ mho cm}^2 \text{ eq}^{-1}}{391 \text{ mho cm}^2 \text{ eq}^{-1}} = 0.00358$$

$$K_a = \frac{\alpha^2 C}{1 - \alpha} = \frac{(0.00358)^2 \times 0.0128}{1 - 0.00358} = 1.6 \times 10^{-7}$$

**OR**

Refer to answer 80, Page no. 41 (MTG CBSE Champion Chemistry Class 12).

(ii) Conductivity ( $\kappa$ ) =  $0.146 \times 10^{-3} \text{ S cm}^{-1}$ ,  
resistance ( $R$ ) =  $1500 \Omega$

$$\text{Cell constant} = \frac{\text{Conductivity}}{\text{Conductance}}$$

$$= \text{Conductivity} \times \text{Resistance}$$

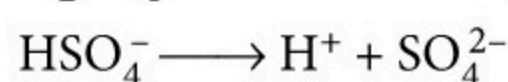
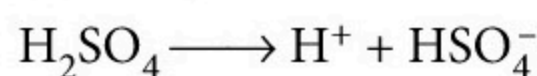
$$= \kappa \times R = 0.146 \times 10^{-3} \times 1500 = 0.219 \text{ cm}^{-1}$$

**37. (i)** (a)  $\text{CaF}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{CaSO}_4 + 2\text{HF}$

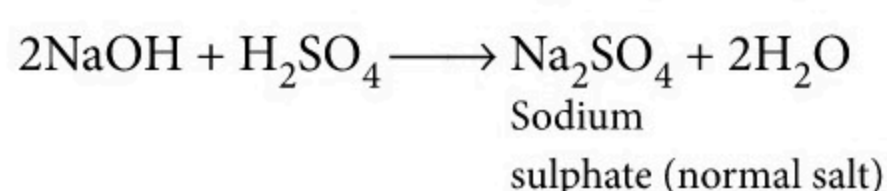
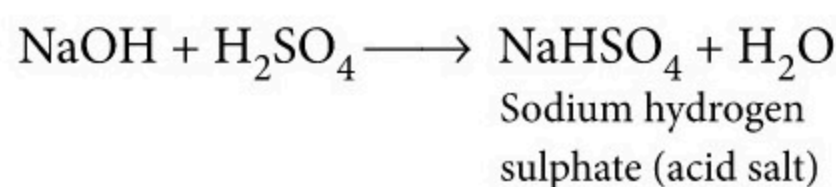
(b)  $\text{SO}_3 + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_4$

$\text{SO}_3$  dissolves in water to form  $\text{H}_2\text{SO}_4$ .

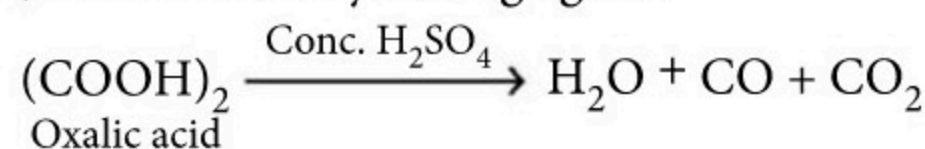
**(ii)** (a) In aqueous solution,  $\text{H}_2\text{SO}_4$  ionizes in two steps :



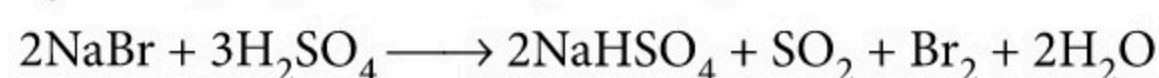
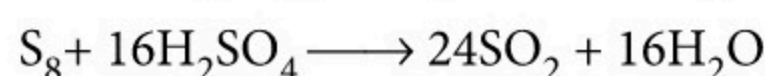
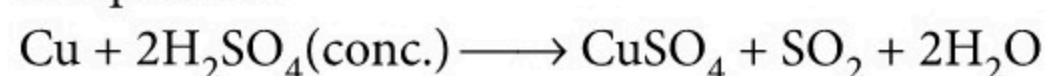
Thus,  $\text{H}_2\text{SO}_4$  acts as a strong dibasic acid and forms two series of salts-normal sulphates such as sodium sulphate and acid sulphates such as sodium bisulphate.



(b)  $\text{H}_2\text{SO}_4$  has great affinity for water molecules and hence, it acts as a dehydrating agent.



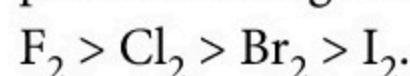
(c)  $\text{H}_2\text{SO}_4$  oxidises metals, non-metals and other compounds.



**OR**

(i) The oxoacid of phosphorus containing +3 oxidation state, undergoes disproportionation to yield compounds in higher and lower oxidation states. Hence,  $\text{H}_3\text{PO}_3$  undergoes disproportionation reaction but  $\text{H}_3\text{PO}_4$  does not, as in it phosphorus is already in highest oxidation state (+5).

(ii) (a) From top to bottom in group-17 oxidising power of halogens decreases.



(b) The acidic strength of the hydrohalic acids increases in the order :  $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

This order is a result of bond dissociation enthalpies of  $\text{H}-\text{X}$  bond, which decreases from  $\text{H}-\text{F}$  to  $\text{H}-\text{I}$  as the size of halogen atom increases.

(iii) Refer to answer 132, Page no. 112 (MTG CBSE Champion Chemistry Class 12).



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**HIGHLIGHTS**

- Comprehensive theory strictly based on NCERT, complemented with illustrations, activities and solutions of NCERT questions
- Practice questions & Model Test Papers for Board Exams
- Previous years' CBSE Board Examination Papers (Solved)
- CBSE Board Paper 2019 Included

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# 10 MUST KNOW TIPS TO SCORE ABOVE 95% IN CHEMISTRY CBSE BOARD EXAM 2020

Here are the 10 must know tips to score high in Chemistry :

## 1 Division of Marks

In Chemistry, out of 70 marks, 20 marks will be given to objective type questions which will include MCQs, paragraph based questions, assertion and reason type questions, and one-word answer type questions. Thus out of 70 marks, only 50 will be given to the subjective type questions where the students are required to write the detailed answers.

It seems that objective questions will be easier than subjective questions but the students must know that to answer these questions; they have to study each and every topic with proper understanding.

## 2 Preparation from NCERT is the Most Important Step

In chemistry, the question paper is entirely based on the content from NCERT books, so the students need to prepare from NCERT. They should go through the entire content, every diagram, every graph, explanation under the diagram, footnote, etc.

They need to practice all the intext NCERT questions, solved examples and exercise questions from all the chapters many times.

**Refer to MTG NCERT Textbook + Exemplar Problems Solutions Class 12**

## 3 Important Units/Chapters

Generally, 5 marks questions are asked from the following units/chapters :

1. Electrochemistry
2. Chemical Kinetics
3. The *p*-Block elements
4. The *d*- and *f*-Block Elements
5. Aldehydes, Ketones and Carboxylic Acids.

Students should concentrate more on the above-stated units.

## 4 Written Practice

Chemical equations from both organic and inorganic chemistry are easy to understand but difficult to learn. Students should practise these reactions by writing them as much as possible.

## 5 Solving Numericals : For solving numerical questions, keep the following things in mind :

- First, write all the information provided, then write the formula and put all the values with their units.

- At last, instead of giving much time to calculations, leave space for the numerical value in answer, but write unit.
- After completing the paper, do calculations for the final answer to the numerical questions.

Sometimes, students are too much involved in calculations, that later they fail to manage time and the entire exam gets affected.

## 6 Preparation of Organic Chemistry

Students should write named reactions, tests to distinguish between compounds and conversions from all the units of organic chemistry altogether in the form of notes and then do written practice of them many times.

## 7 Preparation of Inorganic Chemistry

Generally, three types of questions are asked from inorganic chemistry viz. to complete the equations, to draw the structures and conceptual questions. Conceptual questions and structures are easier to prepare than equations, so students should give preference to these questions. If there is an internal choice in the questions of inorganic chemistry, give preference to structures and conceptual rather than to equations.

## 8 Preparation of Tail Chapters

Often we say that the last three chapters of 'Biomolecules', 'Polymers' and 'Chemistry in Everyday Life' are tail chapters. These three chapters are very scoring; students should prepare very short notes of these chapters in tabular form and should have a quick review of them.

## 9 Solving Previous Years' Question Papers

Students should solve the previous years' question papers like mock tests because while solving the question papers of previous years, students understand the time management and develop the temperament of facing the challenges of the exam.

## 10 Solving Sample Papers

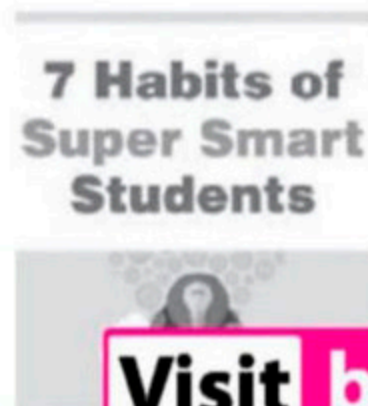
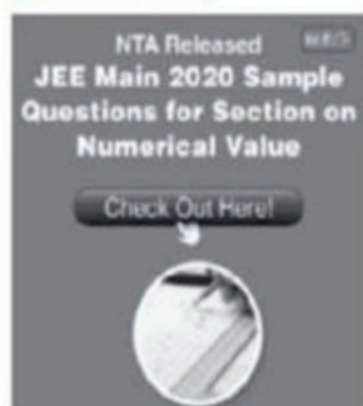
Students should solve at least 10 sample papers of Chemistry. It will definitely improve their confidence and prepare them to face the challenges.

**Refer to MTG 21 ScoreMore Chemistry Class 12**

**All the best for your board exams.**



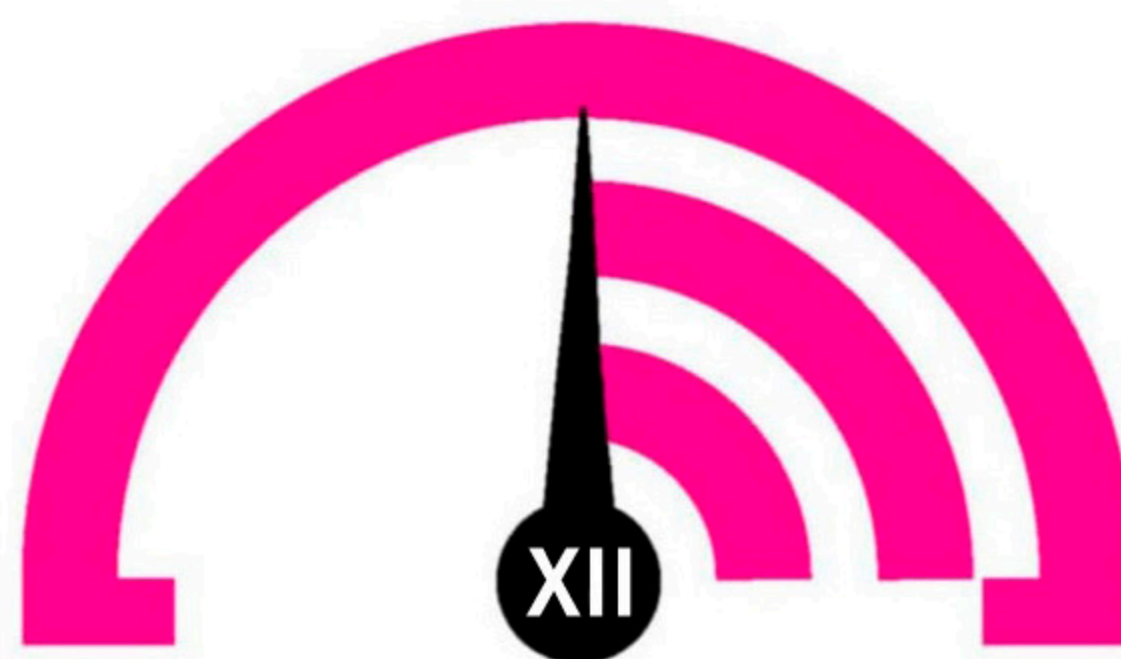
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# MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

## The *p*-Block Elements (Group 15 to 18)

Time Taken : 60 Min.

NEET

Only One Option Correct Type

- Regular use of which of the following fertilizers increases the acidity of soil?  
(a) Ammonium sulphate  
(b) Potassium nitrate  
(c) Urea  
(d) Superphosphate of lime
- Which has maximum pH in aqueous solution ?  
(a) NaClO (b) NaClO<sub>2</sub>  
(c) NaClO<sub>3</sub> (d) NaClO<sub>4</sub>
- Which of the following pairs are isostructural?  
(a) XeF<sub>2</sub>, IF<sub>2</sub><sup>-</sup> (b) NH<sub>3</sub>, BF<sub>3</sub>  
(c) CO<sub>3</sub><sup>2-</sup>, SO<sub>3</sub><sup>2-</sup> (d) PCl<sub>5</sub>, ICl<sub>5</sub>
- Choose the incorrect statement among the following.  
(a) In vapour state, Cl<sub>2</sub>O<sub>6</sub> exists as ClO<sub>3</sub> monomer having one unpaired electron and is paramagnetic in nature.  
(b) In solid state, it is diamagnetic and dimeric, having all the electrons paired  
(c) In Cl<sub>2</sub>O<sub>6</sub>, Cl is *d*<sup>2</sup>*sp*<sup>3</sup> hybridized.  
(d) In Cl<sub>2</sub>O<sub>6</sub>, Cl is *sp*<sup>3</sup> hybridized.
- Which of the following reactions is incorrectly matched ?  
(a) CsBr<sub>3</sub> ⇌ Cs<sup>+</sup> + Br<sub>3</sub><sup>-</sup>  
(b) I<sub>4</sub>O<sub>9</sub> ⇌ I<sup>3+</sup> + 3(IO<sub>3</sub>)<sup>-</sup>  
(c) AgBrO<sub>3</sub> ⇌ Ag<sup>+</sup> + BrO<sub>3</sub><sup>-</sup>  
(d) I<sub>2</sub>O<sub>4</sub> ⇌ IO<sub>2</sub><sup>+</sup> + IO<sub>2</sub><sup>-</sup>
- When concentrated H<sub>2</sub>SO<sub>4</sub> is heated with P<sub>2</sub>O<sub>5</sub>, the acid is converted into  
(a) a mixture of sulphur dioxide and sulphur trioxide  
(b) sulphur trioxide  
(c) sulphur dioxide (d) sulphur.
- The decreasing order of the boiling points of the following hydrides is  
(i) NH<sub>3</sub> (ii) PH<sub>3</sub> (iii) AsH<sub>3</sub> (iv) SbH<sub>3</sub> (v) H<sub>2</sub>O  
(a) (v) > (iv) > (i) > (iii) > (ii)  
(b) (v) > (i) > (ii) > (iii) > (iv)  
(c) (ii) > (iv) > (iii) > (i) > (v)  
(d) (iv) > (iii) > (i) > (ii) > (v)
- $$X \xrightarrow{\text{KOH}} Y \text{ (gas turns red litmus to blue) + } Z$$
$$X \xrightarrow{\text{Zn + KOH}} Y$$
$$X \xrightarrow{\Delta} \text{gas (support combustion)}$$
Identify (X) to (Z).  
(a) X = NH<sub>4</sub>NO<sub>2</sub>, Y = NH<sub>3</sub>, Z = KNO<sub>2</sub>  
(b) X = (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, Y = NH<sub>3</sub>, Z = Cr<sub>2</sub>O<sub>3</sub>  
(c) X = (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Y = NH<sub>3</sub>, Z = K<sub>2</sub>SO<sub>4</sub>  
(d) X = NH<sub>4</sub>NO<sub>3</sub>, Y = NH<sub>3</sub>, Z = KNO<sub>3</sub>
- When F<sub>2</sub> reacts with hot and conc. alkali, then which of the following will be obtained ?  
(i) OF<sub>2</sub> (ii) O<sub>2</sub> (iii) H<sub>2</sub>O (iv) NaF  
(a) (i), (iii) and (iv) (b) (i), (ii) and (iii)  
(c) (ii), (iii) and (iv) (d) all of these
- Phosphorous acid on heating gives the following products :
$$4\text{H}_3\text{PO}_3 \xrightarrow{\Delta} 3\text{H}_3\text{PO}_4 + \text{PH}_3$$
The above reaction is an example of  
(a) oxidation  
(b) thermal decomposition  
(c) disproportionation  
(d) reduction.
- MF + XeF<sub>4</sub> → A (where M<sup>+</sup> is alkali metal cation); the hybridization of central atom of A and its shape are



- (a)  $sp^3d$ , trigonal bipyramidal
- (b)  $sp^3d^2$ , distorted octahedral
- (c)  $sp^3d^3$ , pentagonal planar
- (d) no such compound is formed.

12. Which one of the following orders correctly represents the increasing acidic strengths of the given acids?

- (a)  $\text{HOClO} < \text{HOCl} < \text{HOClO}_3 < \text{HOClO}_2$
- (b)  $\text{HOClO}_2 < \text{HOClO}_3 < \text{HOClO} < \text{HOCl}$
- (c)  $\text{HOClO}_3 < \text{HOClO}_2 < \text{HOClO} < \text{HOCl}$
- (d)  $\text{HOCl} < \text{HOClO} < \text{HOClO}_2 < \text{HOClO}_3$

### Assertion & Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- (c) If assertion is true but reason is false.
- (d) If both assertion and reason are false.

13. **Assertion :** H—S—H bond angle in  $\text{H}_2\text{S}$  is closer to  $90^\circ$  but H—O—H bond angle in  $\text{H}_2\text{O}$  is  $104.5^\circ$ .

**Reason :** Lone pair-lone pair repulsion is stronger in  $\text{H}_2\text{S}$  than in  $\text{H}_2\text{O}$

14. **Assertion :** Concentrated sulphuric acid cannot be used for the preparation of HBr from NaBr.

**Reason :** HBr being strong reducing agent, reduces  $\text{H}_2\text{SO}_4$  to  $\text{SO}_2$  and is itself oxidised to  $\text{Br}_2$ .

15. **Assertion :** For drying ammonia gas, the common dehydrating agents like  $\text{H}_2\text{SO}_4$ ,  $\text{CaCl}_2$  or  $\text{P}_2\text{O}_5$  cannot be used.

**Reason :**  $\text{H}_2\text{SO}_4$ ,  $\text{CaCl}_2$  or  $\text{P}_2\text{O}_5$  react with  $\text{NH}_3$ .

### JEE MAIN / ADVANCED

#### Only One Option Correct Type

16. An inorganic halide (A) reacts with water to form two acids (B) and (C). (A) also reacts with NaOH to form two salts (D) and (E) which remain in solution. The solution gives white precipitate with both  $\text{AgNO}_3$  and  $\text{BaCl}_2$  solutions respectively. (A) is a useful organic reagent. The compound (A) is  
(a)  $\text{SOCl}_2$  (b)  $\text{SO}_2\text{Cl}_2$  (c)  $\text{S}_2\text{Cl}_2$  (d)  $\text{SF}_4$
17. An amorphous solid (X) burns in air to form a gas (Y) which turns limewater milky. This gas decolourises aqueous solution of acidified  $\text{KMnO}_4$ . Gas (Y) reacts with oxygen to give another gas (Z) which is responsible for acid rain. X, Y and Z are

| X     | Y                      | Z                       |
|-------|------------------------|-------------------------|
| (a) C | CO                     | $\text{CO}_2$           |
| (b) S | $\text{SO}_2$          | $\text{SO}_3$           |
| (c) P | $\text{P}_2\text{O}_3$ | $\text{P}_2\text{O}_5$  |
| (d) S | $\text{SO}_3$          | $\text{H}_2\text{SO}_4$ |

18. A colourless inorganic salt (A) decomposes completely at about 523 K to give only two products (B) and (C) leaving no residue. The product (B) is a neutral gas while the product (C) is liquid at room temperature and is neutral to litmus. White phosphorus burns in excess of (B) to produce a strong dehydrating agent  $\text{P}_4\text{O}_{10}$ . The compounds (A), (B) and (C) are respectively

- (a)  $\text{NH}_4\text{NO}_2$ ,  $\text{N}_2$ ,  $\text{H}_2\text{O}$  (b)  $\text{NH}_4\text{NO}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{H}_2\text{O}$
- (c)  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_3$ ,  $\text{HCl}$  (d)  $\text{NaNO}_3$ ,  $\text{O}_2$ ,  $\text{NaNO}_2$

19.  $\text{Xe}_{(g)} + \text{PtF}_{6(g)} \longrightarrow \text{A} \xrightarrow[25^\circ\text{C}]{\text{PtF}_6} \text{B} \xrightarrow[60^\circ\text{C}]{\text{PtF}_6} \text{C}$   
A, B and C respectively are

- (a)  $\text{Xe}^+[\text{PtF}_6]^-$ ,  $[\text{XeF}]^+[\text{Pt}_2\text{F}_{11}]^-$ ,  $[\text{XeF}]^+[\text{Pt}_3\text{F}_{16}]^-$
- (b)  $[\text{XeF}]^+[\text{PtF}_6]^-$ ,  $[\text{XeF}]^+[\text{Pt}_2\text{F}_{11}]^-$ ,  $[\text{XeF}]^+[\text{Pt}_3\text{F}_{16}]^-$
- (c)  $[\text{XeF}]^+[\text{PtF}_6]^-$ ,  $[\text{XeF}_2]^+[\text{Pt}_2\text{F}_{11}]^-$ ,  $[\text{XeF}_3]^+[\text{Pt}_3\text{F}_{16}]^-$
- (d)  $\text{Xe}^+[\text{PtF}_6]^-$ ,  $[\text{XeF}]^+[\text{PtF}_6]^-$ ,  $[\text{XeF}]^+[\text{Pt}_2\text{F}_{11}]^-$

#### More than One Options Correct Type

20. Which of the following statements about sulphur are correct ?

- (a) Sulphur exists as  $\text{S}_8$  octaatomic molecule with puckered ring structure.
- (b) In  $\text{S}_8$  molecule, each S atom is  $sp^3$ - hybridized involving both bonding and non-bonding pairs of electrons.
- (c)  $\text{S}_8$  molecule is associated with 8 S—S bonds and 16 lone pairs.
- (d) The S—S—S bond angle in  $\text{S}_8$  molecule is  $109.5^\circ$ .

21. Which of the following reactions can evolve phosphine?

- (a) White P +  $\text{Ca}(\text{OH})_2 \longrightarrow$
- (b)  $\text{AlP} + \text{H}_2\text{SO}_4 \longrightarrow$
- (c)  $\text{H}_3\text{PO}_3 \xrightarrow{\text{Heat}}$
- (d)  $\text{PH}_4\text{I} + \text{NaOH} \longrightarrow$

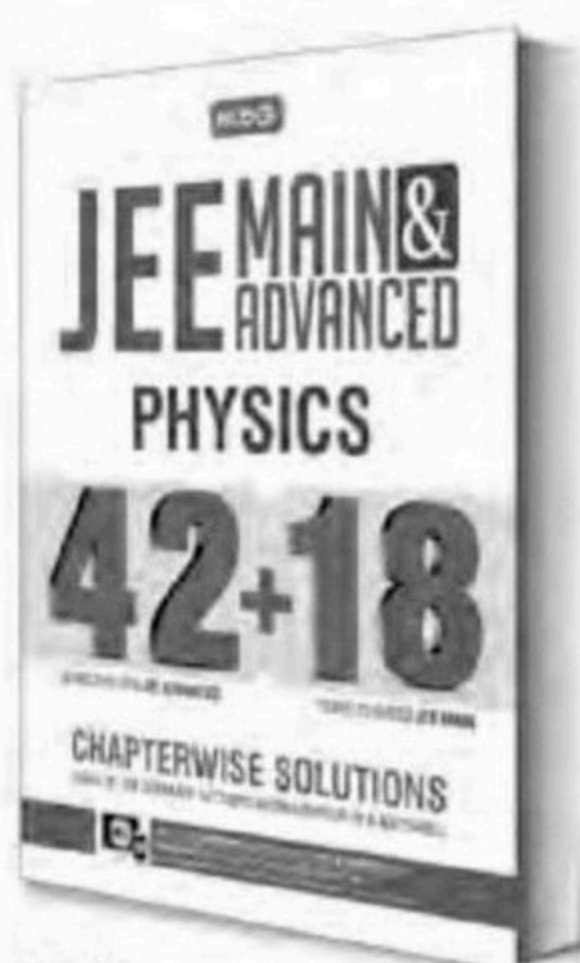
22. Which amongst the following statements are correct?

- (a)  $\text{XeF}_4$  and  $\text{SbF}_5$  combine to form salt.
- (b) He and Ne do not form clathrates.
- (c) He has highest boiling point in its group.
- (d) Mixture of He and  $\text{O}_2$  is used for respiration by sea divers.

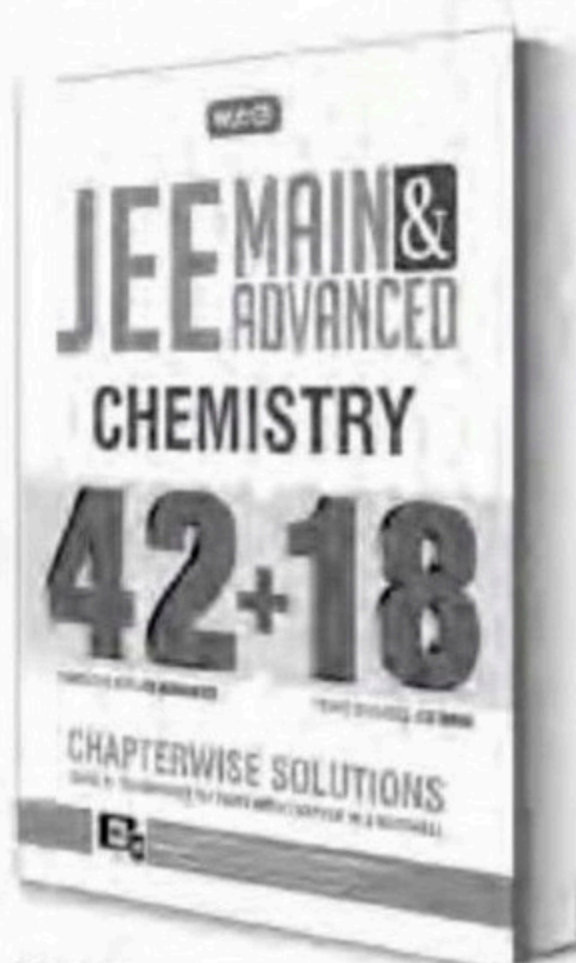


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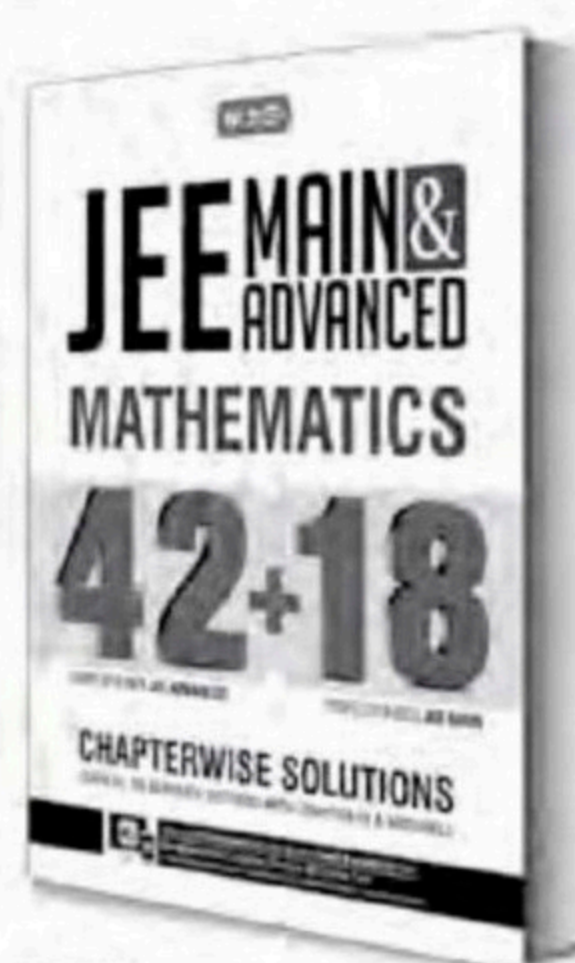
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23. Astatine is the element below iodine in group 17 in periodic table. Which of the following statements are true for astatine ?
- It is less electronegative than iodine.
  - It exhibits only  $-1$  oxidation state.
  - It is composed of diatomic molecules.
  - Intermolecular forces will be larger than iodine.

#### Numerical Value Type

24. Fluorine reacts with cold and dilute NaOH solution to give NaF,  $H_2O$  and X. It also reacts with hot and concentrated NaOH to give NaF,  $H_2O$  and Y. The difference in the oxidation states of O in X and Y is
25. Sodium iodate is treated with calculated amount of sodium bisulphite to prepare iodine. How many moles of sodium bisulphite are required to prepare one mole of iodine from sodium iodate ?
26. Among the following, the number of compounds that can react with  $PCl_5$  to give  $POCl_3$  is  $O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}$

#### Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

All the halogens combine directly with hydrogen to form covalent molecular hydrides. The reactivity of the halogens decreases from fluorine to iodine. Aqueous solutions of hydrogen halides are known as hydrohalic acids. These can be prepared by heating their respective salts with acids.

| Column-I |                  | Column-II |                    |
|----------|------------------|-----------|--------------------|
| (P)      | Euchlorine       | I.        | $KClO_3$           |
| (Q)      | Berthelots salts | II.       | $CCl_3 \cdot NO_2$ |
| (R)      | Anhydrone        | III.      | $ClO_2 + Cl_2$     |
| (S)      | Tear gas         | IV.       | $Mg(ClO_4)_2$      |

27. Which of the following has the correct combination considering column-I and column-II?
- $P \rightarrow I$
  - $Q \rightarrow IV$
  - $R \rightarrow III$
  - $S \rightarrow II$

28. Which of the following has the correct combination considering column-I and column-II?
- $P \rightarrow III$
  - $Q \rightarrow II$
  - $R \rightarrow I$
  - $S \rightarrow IV$

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

The binary compounds of oxygen with other elements are called oxides. They are classified either depending upon their acid-base characteristics or on the basis of oxygen content.

- Normal oxides** : These oxides which contain oxygen atoms as permitted by the normal oxidation number, i.e.,  $-2$ . Normal oxide may be acidic, basic, amphoteric or neutral.
- Polyoxides** : The oxides which contain oxygen atoms different than those permitted by the normal oxidation number of  $-2$ .
  - Peroxides** : Two oxygen atoms are linked to each other and each oxygen has  $-1$  oxidation number. They contain  $(O-O)^{2-}$  unit.
  - Superoxides** : These oxides contain  $(O-O)^-$  unit. i.e., each O-atom has oxidation number  $-1/2$ .
  - Suboxides** : These contain low content of oxygen than expected.
  - Mixed oxides** : These oxides are made of two simpler oxides.

| Column-I (Oxides) |                   | Column-II (Species) |                    |
|-------------------|-------------------|---------------------|--------------------|
| (P)               | Suboxides         | I.                  | $Pb_3O_4, Fe_3O_4$ |
| (Q)               | Mixed oxides      | II.                 | $N_2O, C_3O_3$     |
| (R)               | Amphoteric oxides | III.                | $CO, NO$           |
| (S)               | Neutral oxides    | IV.                 | $BeO, Al_2O_3$     |

29. Which of the following has the correct combination considering column-I and column-II?
- $P \rightarrow II$
  - $Q \rightarrow IV$
  - $R \rightarrow III$
  - $S \rightarrow I$
30. Which of the following has the correct combination considering column-I and column-II?
- $P \rightarrow III$
  - $Q \rightarrow I$
  - $R \rightarrow IV$
  - $S \rightarrow II$

Keys are published in this issue. Search now! ☺

## SELF CHECK

No. of questions attempted .....  
 No. of questions correct .....  
 Marks scored in percentage .....

### Check your score! If your score is

|        |                   |  |
|--------|-------------------|--|
| > 90%  | EXCELLENT WORK !  | You are well prepared to take the challenge of final exam. |
| 90-75% | GOOD WORK !       | You can score good in the final exam.                      |
| 74-60% | SATISFACTORY !    | You need to score more next time.                          |
| < 60%  | NOT SATISFACTORY! | Revise thoroughly and strengthen your concepts.            |



# GET SET GO

for

# NEET

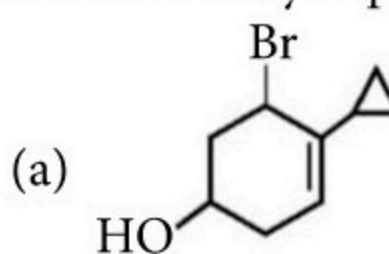
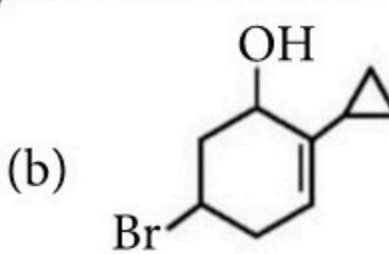
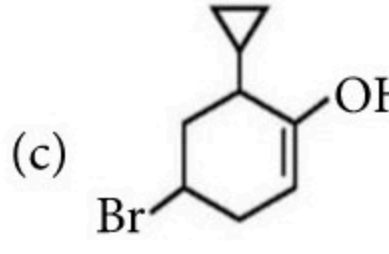
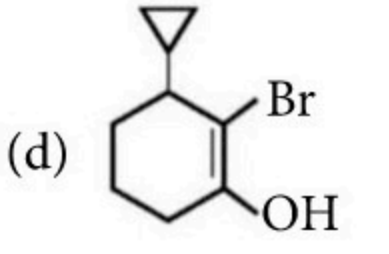
Exam on  
May 3, 2020



*with exclusive and brain storming MCQs*

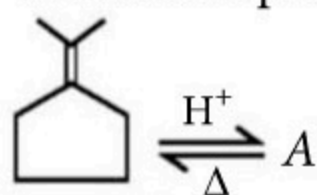
Practicing these MCQs help to strengthen your concepts and give you extra edge in your NEET preparation

## Only One Option Correct Type

- At moderate pressure, the van der Waals' equation is reduced to  
 (a)  $Z = \frac{pV_m}{RT} = 1 - \frac{aP}{RT}$  (b)  $Z = \frac{pV_m}{RT} = 1 + \frac{b}{RT}P$   
 (c)  $pV_m = RT + a/V^2$  (d)  $Z = \frac{pV_m}{RT} = 1 - \frac{a}{RT}$
- Which of the following is the correct structure of 5-bromo-2-cyclopropylcyclohex-2-en-1-ol?  
 (a)  (b)   
 (c)  (d) 
- Which of the following is the correct statement?  
 (a) CO which is major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog.  
 (b) Classical smog has an oxidizing character while the photochemical smog is reducing in character.  
 (c) Photochemical smog occurs in day time whereas the classical smog occurs in early morning hours.  
 (d) During formation of smog the level of ozone in the atmosphere goes down.
- A metal ( $M$ ) burns with dazzling brilliance in air to give a white powder. The white powder reacts with water to form a white precipitate and a colourless gas with a characteristic smell. The metal ( $M$ ) decomposes hot water but not cold water, liberating the inflammable hydrogen gas. The metal ( $M$ ) is  
 (a) K (b) Ca (c) Mg (d) Rb
- Enthalpy of formation of gaseous  $H_2O$  at 298 K is  $-241.8 \text{ kJ mol}^{-1}$ . What would be its value at the standard boiling point of water?  
 Given the following value of molar heat capacities ( $C_p$ ) at constant pressure (assume them to be temperature independent).  
 $C_p(H_2O_{(g)}) = 33.58 \text{ JK}^{-1} \text{ mol}^{-1}$ ;  
 $C_p(H_2) = 28.90 \text{ JK}^{-1} \text{ mol}^{-1}$ ;  
 $C_p(O_2) = 29.39 \text{ JK}^{-1} \text{ mol}^{-1}$   
 (a)  $-231.05 \text{ kJ mol}^{-1}$  (b)  $-242.55 \text{ kJ mol}^{-1}$   
 (c)  $-991.8 \text{ kJ mol}^{-1}$  (d)  $242.55 \text{ kJ mol}^{-1}$



6. If radiation corresponding to second line of "Balmer series" of  $\text{Li}^{2+}$  ion, knocked out electron from first excited state of H-atom, then kinetic energy of ejected electron would be  
 (a) 2.55 eV (b) 4.25 eV  
 (c) 11.25 eV (d) 19.55 eV
7. Which of the following statements is wrong?  
 (a) van der Waals' radius of iodine is more than its covalent radius.  
 (b) All isoelectronic ions belong to same period of the periodic table.  
 (c)  $I.E._1$  of N is higher than that of O while  $I.E._2$  of O is higher than that of N.  
 (d) The electron affinity of N is almost zero while that of P is  $74.3 \text{ kJ mol}^{-1}$ .
8. The pH of 0.1 M solution of the following compounds increases in the order  
 (a)  $\text{NaCl} < \text{NH}_4\text{Cl} < \text{NaCN} < \text{HCl}$   
 (b)  $\text{HCl} < \text{NH}_4\text{Cl} < \text{NaCl} < \text{NaCN}$   
 (c)  $\text{NaCN} < \text{NH}_4\text{Cl} < \text{NaCl} < \text{HCl}$   
 (d)  $\text{HCl} < \text{NaCl} < \text{NaCN} < \text{NH}_4\text{Cl}$
9. Match List-I with List-II and select the correct answer.
- | List-I (ion)         | List-II (shapes) |
|----------------------|------------------|
| A. $\text{ICl}_2^-$  | 1. Linear        |
| B. $\text{ClO}_3^-$  | 2. Pyramidal     |
| C. $\text{ClF}_4^-$  | 3. Tetrahedral   |
| D. $\text{AlCl}_4^-$ | 4. Square planar |
- (a) A-1, B-2, C-3, D-4 (b) A-4, B-1, C-2, D-3  
 (c) A-1, B-2, C-4, D-3 (d) A-2, B-1, C-3, D-4
10. When a substance A reacts with water it produces a combustible gas B and a solution of substance C in water. When another substance D reacts with this solution of C, it also produces the same gas B on warming but D can produce B on reaction with dilute sulphuric acid at room temperature. A imparts a golden yellow colour to a smokeless flame of Bunsen flame. A, B, C and D are respectively  
 (a) K,  $\text{H}_2$ , KOH and Al  
 (b) Na,  $\text{H}_2$ , NaOH and Zn  
 (c)  $\text{CaC}_2$ ,  $\text{C}_2\text{H}_2$ ,  $\text{Ca}(\text{OH})_2$  and Fe  
 (d) Ca,  $\text{H}_2$ ,  $\text{Ca}(\text{OH})_2$  and Sn
11. Predict the product (A) of the following reaction



- (a) (b)
- (c) (d)

12. 3.92 g of ferrous ammonium sulphate crystals are dissolved in 100 mL of water. 20 mL of this solution requires 18 mL of potassium permanganate during titration for complete oxidation. The weight of  $\text{KMnO}_4$  present in one litre of the solution is  
 (a) 3.476 g (b) 12.38 g (c) 1.238 g (d) 34.76 g.
13. In which of the following reactions,  $\text{H}_2\text{O}_2$  acts as a reducing agent?  
 (a)  $\text{PbO}_{2(s)} + \text{H}_2\text{O}_{2(aq)} \longrightarrow \text{PbO}_{(s)} + \text{H}_2\text{O}_{(l)} + \text{O}_{2(g)}$   
 (b)  $\text{Na}_2\text{SO}_{3(aq)} + \text{H}_2\text{O}_{2(aq)} \longrightarrow \text{Na}_2\text{SO}_{4(aq)} + \text{H}_2\text{O}_{(l)}$   
 (c)  $2\text{KI}_{(aq)} + \text{H}_2\text{O}_{2(aq)} \longrightarrow 2\text{KOH}_{(aq)} + \text{I}_{2(s)}$   
 (d)  $\text{KNO}_{2(aq)} + \text{H}_2\text{O}_{2(aq)} \longrightarrow \text{KNO}_{3(aq)} + \text{H}_2\text{O}_{(l)}$
14. On addition of increasing amount of  $\text{AgNO}_3$  to 0.1 M each of NaCl and NaBr in a solution, what % of  $\text{Br}^-$  ion get precipitated when  $\text{Cl}^-$  ion starts precipitating?  $K_{sp}(\text{AgCl}) = 1.0 \times 10^{-10}$ ,  $K_{sp}(\text{AgBr}) = 1 \times 10^{-13}$   
 (a) 0.11 (b) 99.9 (c) 0.01 (d) 9.99
15. The following redox reaction is balanced by which set of coefficients?  
 $a\text{Zn} + b\text{NO}_3^- + c\text{H}^+ \longrightarrow d\text{NH}_4^+ + e\text{H}_2\text{O} + f\text{Zn}^{2+}$
- | a     | b | c  | d | e | f |
|-------|---|----|---|---|---|
| (a) 1 | 1 | 10 | 1 | 3 | 1 |
| (b) 2 | 2 | 10 | 2 | 3 | 2 |
| (c) 4 | 2 | 10 | 1 | 3 | 4 |
| (d) 4 | 1 | 10 | 1 | 3 | 4 |

## SOLUTIONS

1. (a) : van der Waals' equation is

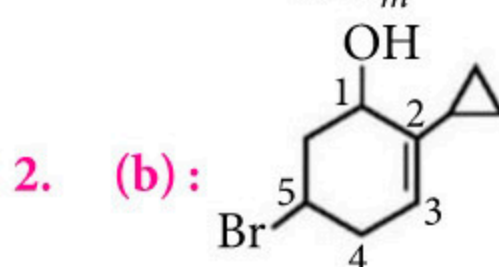
$$\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

where,  $V_m = V/n$  = molar volume. At moderate pressure,  $V_m$  is high and  $b$  can be ignored.

$$\therefore \left(p + \frac{a}{V_m^2}\right)V_m = RT \text{ or } pV_m + \frac{a}{V_m} = RT$$

$$\therefore pV_m = RT - \frac{a}{V_m} \text{ or } \frac{pV_m}{RT} = 1 - \frac{a}{RTV_m}$$

$$\text{or } Z = 1 - \frac{a}{RTV_m} = 1 - \frac{aP}{RT} \quad \left(\text{since } V \propto \frac{1}{P}\right)$$



5-Bromo-2-cyclopropylcyclohex-2-en-1-ol

3. (c) : Photochemical smog occurs in summers during day time whereas classical smog is formed in the early morning hours of winter months.
4. (c) : Hydrogen is liberated when Mg reacts with hot water. Rb, K and Ca gives hydrogen gas even with cold water.









for

## NEET/JEE

Brush up your concepts to get high rank in NEET/JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

2020

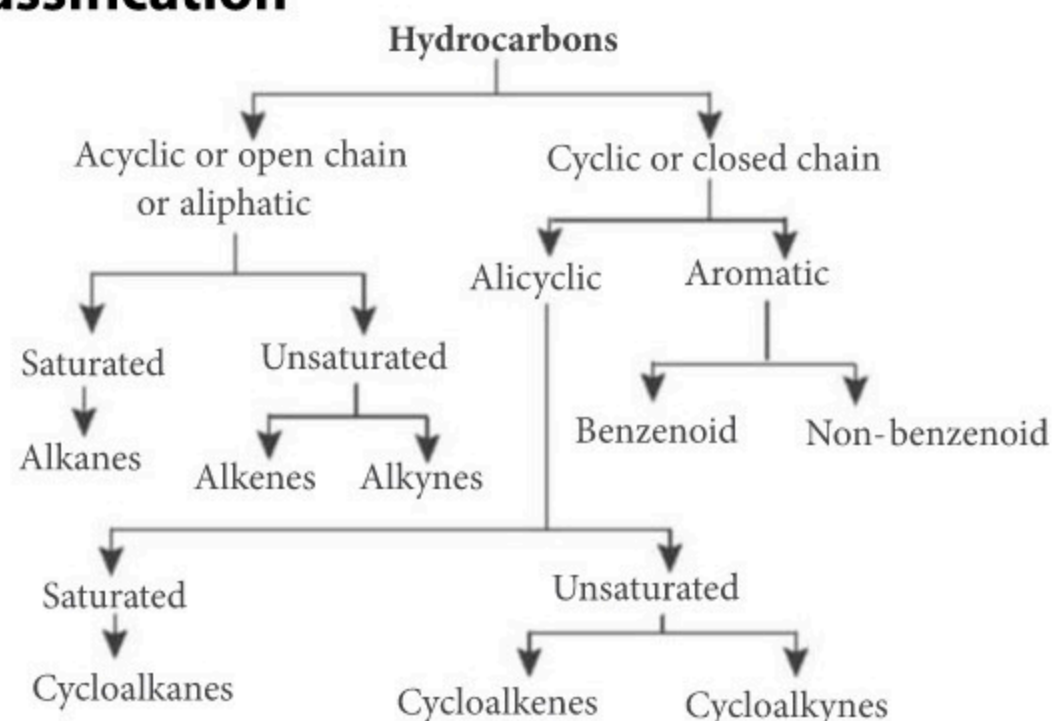
Unit  
8

## Hydrocarbons / Environmental Chemistry

## Hydrocarbons

- Organic compounds composed of only C and H are called hydrocarbons.

## Classification

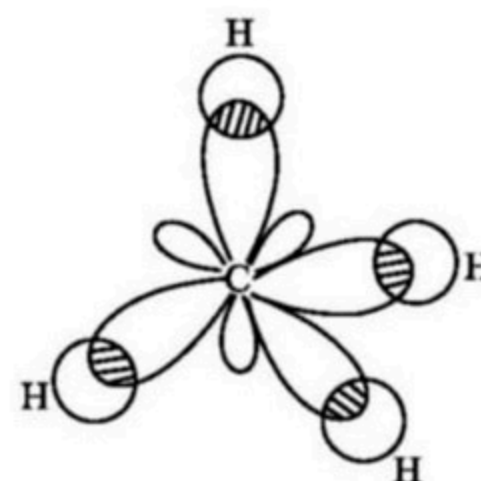


## ALKANES

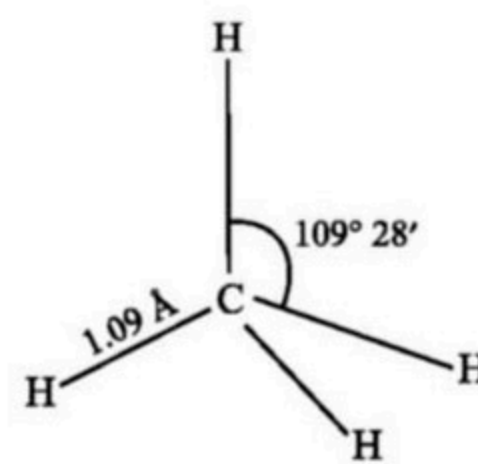
- Alkanes also called paraffins are saturated hydrocarbons with general formula  $C_nH_{2n+2}$ , where,  $n$  is equal to 1, 2, 3.... e.g.,  $CH_4$  (methane),  $C_2H_6$  (ethane),  $C_3H_8$  (propane), etc.

## Structure

- Each carbon atom of alkanes is in  $sp^3$  state of hybridization with its four bonding orbitals directed towards the four corners of a regular tetrahedron.



Overlap of four  $sp^3$  orbitals of carbon with the  $1s$  orbital of four hydrogen atoms



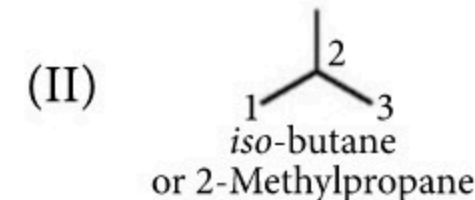
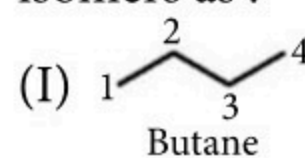
Bond length and bond angle in methane

## Nomenclature

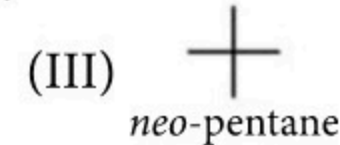
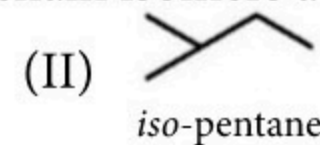
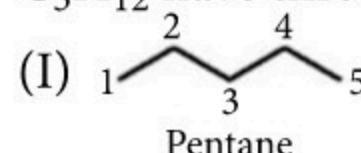
- Root word + ane = alkane  
e.g.,  $CH_3CH_2CH_2CH_3$ ,  $CH_3CH_2CH_2CH_2CH_2CH_3$   
*n*-butane *n*-hexane

## Isomerism

- Alkanes exhibit mainly structural (chain) and conformational isomerism.
- Structural isomerism** : Methane, ethane, propane do not exhibit isomerism.  $C_4H_{10}$  have two chain isomers as :



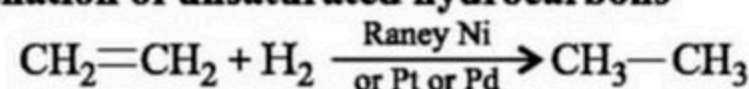
$C_5H_{12}$  have three chain isomers as :



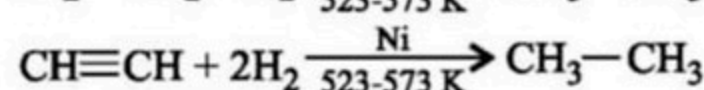
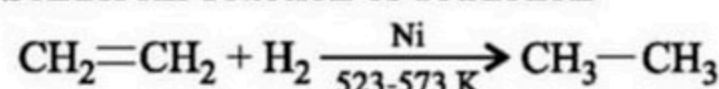


## Methods of Preparation

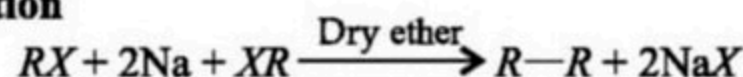
**By hydrogenation of unsaturated hydrocarbons**



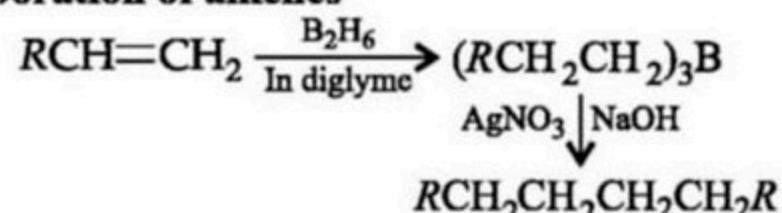
**Sabatier and Senderens reaction or reduction**



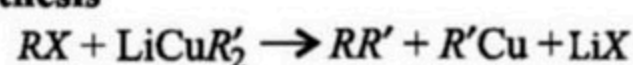
**Wurtz reaction**



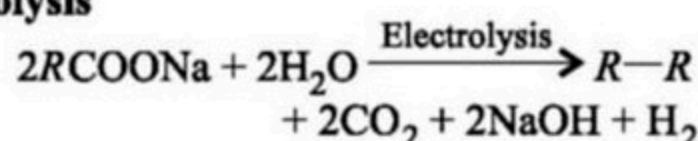
**By hydroboration of alkenes**



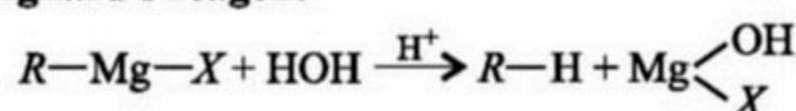
**Corey-House synthesis**



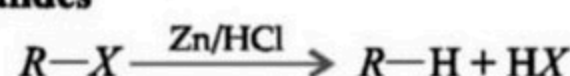
**Kolbe's electrolysis**



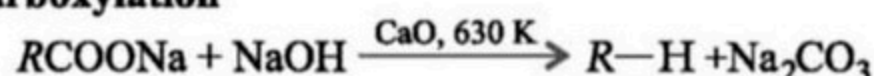
**From Grignard's reagent**



**Reduction of alkyl halides**

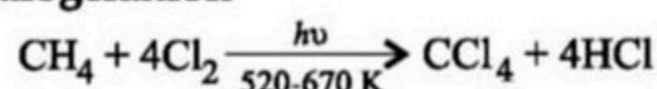


**Decarboxylation**

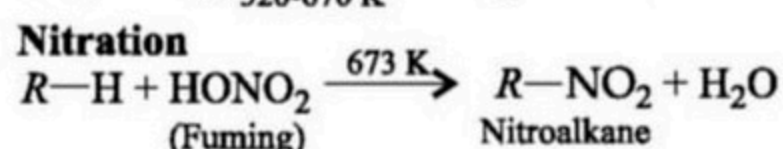


## Chemical Properties

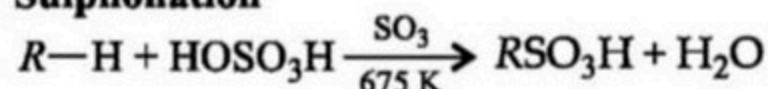
**Halogenation**



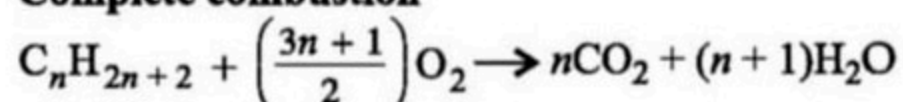
**Nitration**



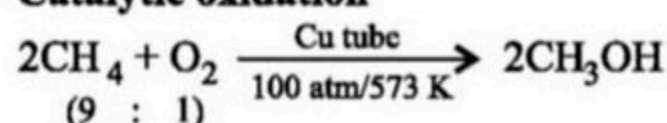
**Sulphonation**



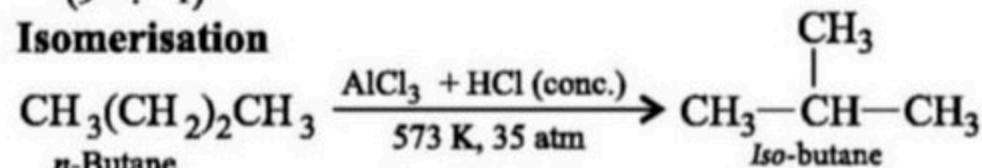
**Complete combustion**



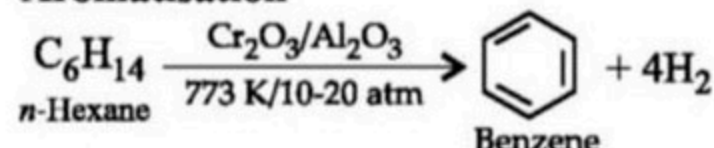
**Catalytic oxidation**



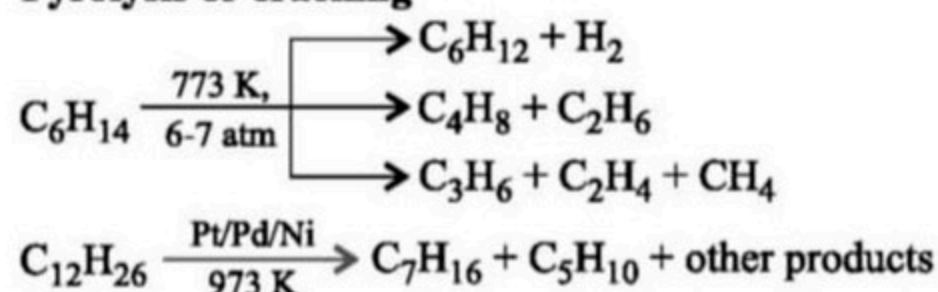
**Isomerisation**



**Aromatisation**



**Pyrolysis or cracking**



## Conformations

- The different arrangements of atoms in space which result from the free rotation of groups about C—C single bond are called conformations or conformers or rotamers.
- Conformations of Ethane (Sawhorse and Newman Projections)**
  - Staggered conformation** : The hydrogen atoms attached to two carbons are far apart and experience minimum repulsion.
  - Eclipsed conformation** : The hydrogen atoms attached to two carbons are as close together as possible and experience maximum repulsion.
  - Gauche or Skew form** : A rotation of 60° converts a staggered conformation into an eclipsed conformation, or *vice-versa*. Rotation between 0° to 60° generates one of the many other arrangements in between staggered and eclipsed forms. These arrangements are called **gauche** or **skew form**.
  - Order of stability** : Staggered > Skew or Gauche > Eclipsed

## ALKENES

- Alkenes also called olefins are unsaturated hydrocarbons which have general formula 'C<sub>n</sub>H<sub>2n</sub>'. They contain double bond (C = C) which is considered as a functional group. *e.g.*, C<sub>2</sub>H<sub>4</sub> (ethene or ethylene), C<sub>3</sub>H<sub>6</sub> (propene or propylene).

## Structure

- In ethylene molecule, one of the sp<sup>2</sup>-hybridised orbitals of one carbon atom overlaps axially with one of the sp<sup>2</sup>-orbitals of another carbon atom. Two

### GLIMPSE OF NEXT ISSUE...

Monthly Test Drive (XI) :

Monthly Test Drive (XII) :

Brush up for NEET/JEE (XI) :

Brush up for NEET/JEE (XII) :

Gear Up for JEE Main 2020 :

NEET Practice Paper 2020

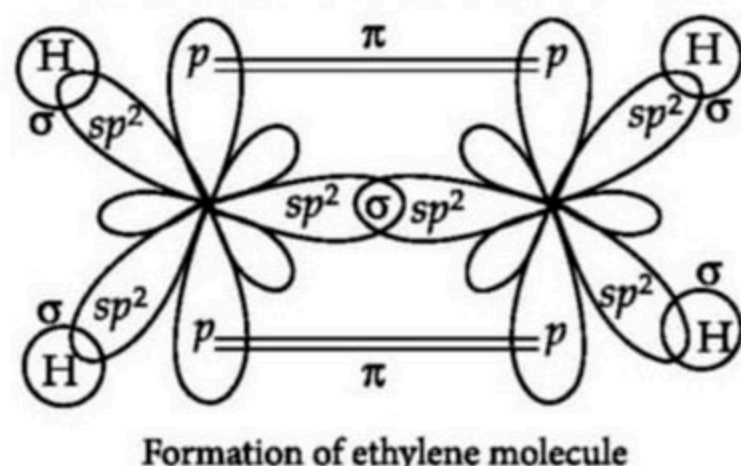
- Equilibrium
- Redox Reactions
- The *d*- and *f*-Block Elements
- Coordination Compounds
- Practical Chemistry

• Practical Chemistry

• Practice Paper



of the  $sp^2$ -hybridised orbitals of each carbon atom overlap separately and along the axes with the  $1s$  orbitals of the hydrogen atoms. The pure  $p$ -orbital on each of the two carbon atoms overlap each other laterally (sideways) and thus, a new type of bond ( $\pi$ ) is formed between the two carbon atoms.



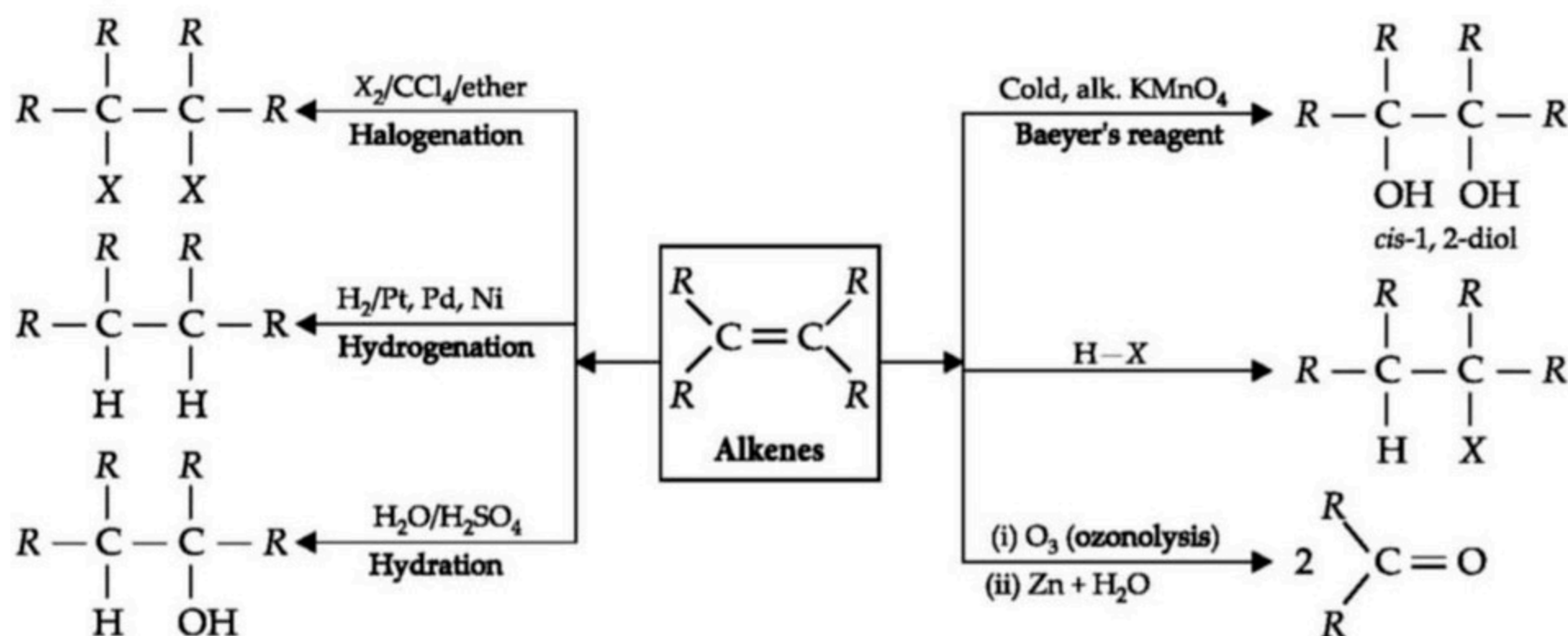
## Nomenclature

- Alkane - ane + ene = alkene  
e.g.,  $\overset{1}{\text{CH}_2}=\overset{2}{\text{CH}}-\overset{3}{\text{CH}_2}-\overset{4}{\text{CH}_2}-\overset{5}{\text{CH}_3}$   
Pent-1-ene (Pentene)

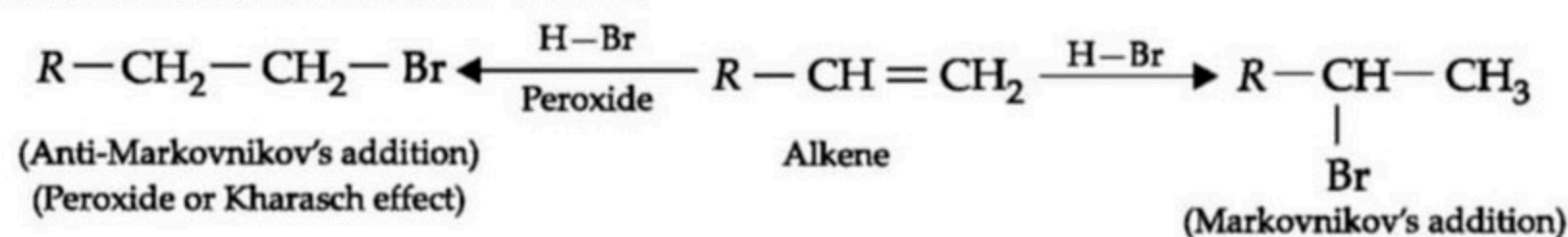
## Isomerism

- Alkenes show following types of isomerism :  
Chain isomerism, position isomerism, ring chain

## Chemical Properties



- Markovnikov's and Anti-Markovnikov's rule :



## ALKYNES

- Alkynes also called acetylenes are unsaturated hydrocarbons which have general formula  $\text{C}_n\text{H}_{2n-2}$ . They contain triple bond. e.g.,  $\text{C}_2\text{H}_2$  ( $\text{HC} \equiv \text{CH}$ ) called acetylene or ethyne and  $\text{HC} \equiv \text{CCH}_3$  called propyne (or methyl acetylene).

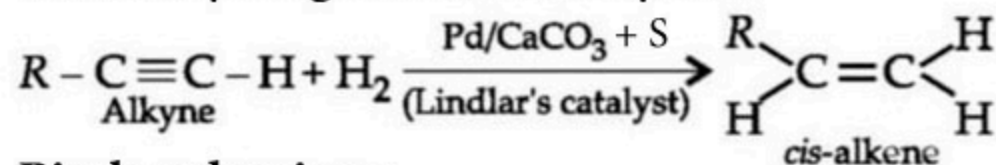
## Structure

- In acetylene molecule, one of the  $sp$ -hybridised orbitals of one carbon atom overlaps axially with

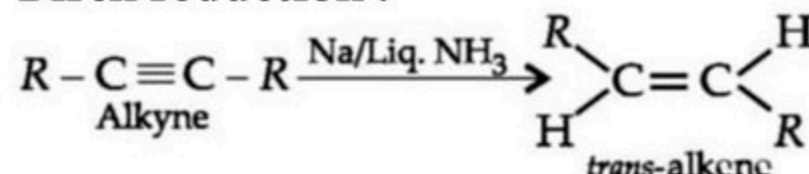
isomerism and geometrical isomerism (*cis-trans* isomerism).

## Methods of Preparation

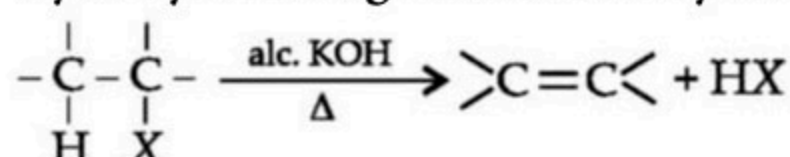
- Partial hydrogenation of alkynes :



- Birch reduction :



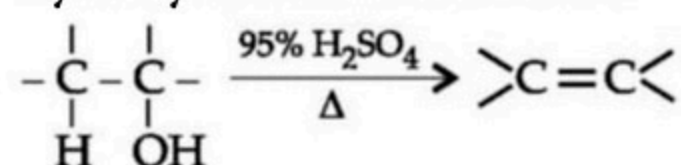
- By dehydrohalogenation of alkyl halides :



- From vicinal dihalides :

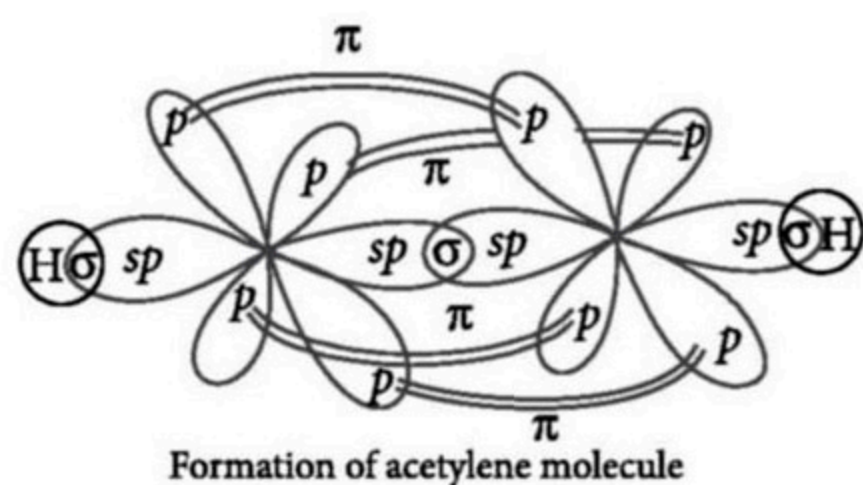


- By dehydration of alcohols :



one of the  $sp$ -hybridised orbitals of the other carbon atom; thus a  $\text{C}-\text{C}$   $\sigma$ -bond is formed. Second  $sp$ -hybridised orbitals of each carbon atom overlaps axially and separately with the  $1s$  orbitals of the two hydrogen atoms and thus two  $\text{C}-\text{H}$   $\sigma$ -bonds are formed. The remaining two pure  $p$ -orbitals of one carbon atom overlaps sideways with the corresponding  $p$ -orbitals of the other carbon atom and thus, two  $\text{C}-\text{C}$   $\pi$ -bonds are formed.





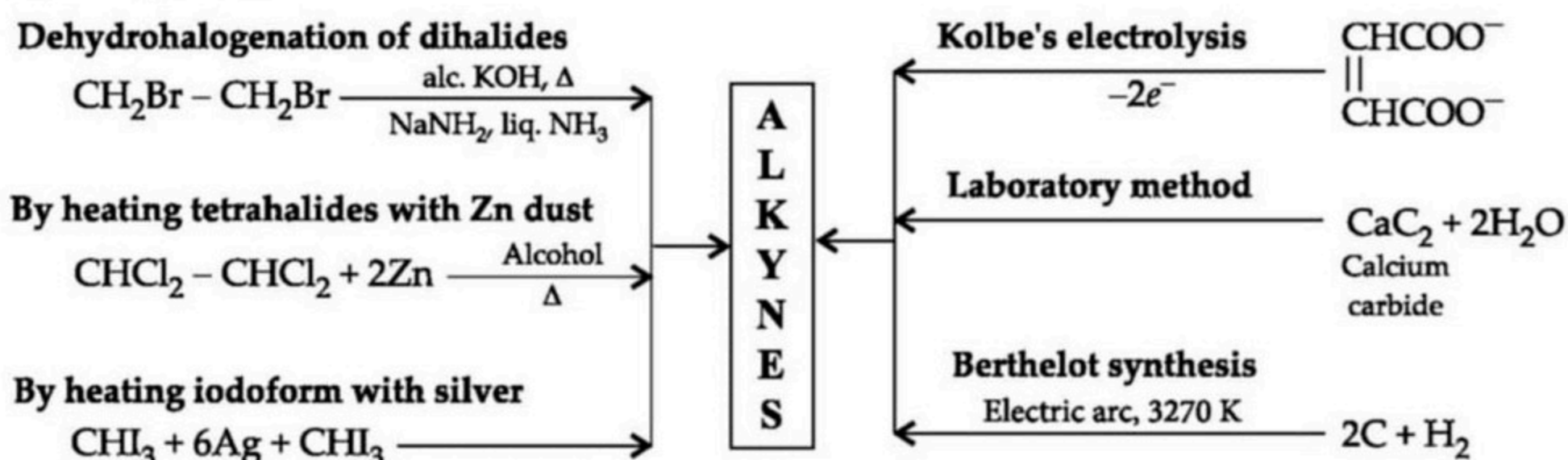
## Nomenclature

- alkane - ane + yne = alkyne  
e.g.,  $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$   
Hex-2-yne

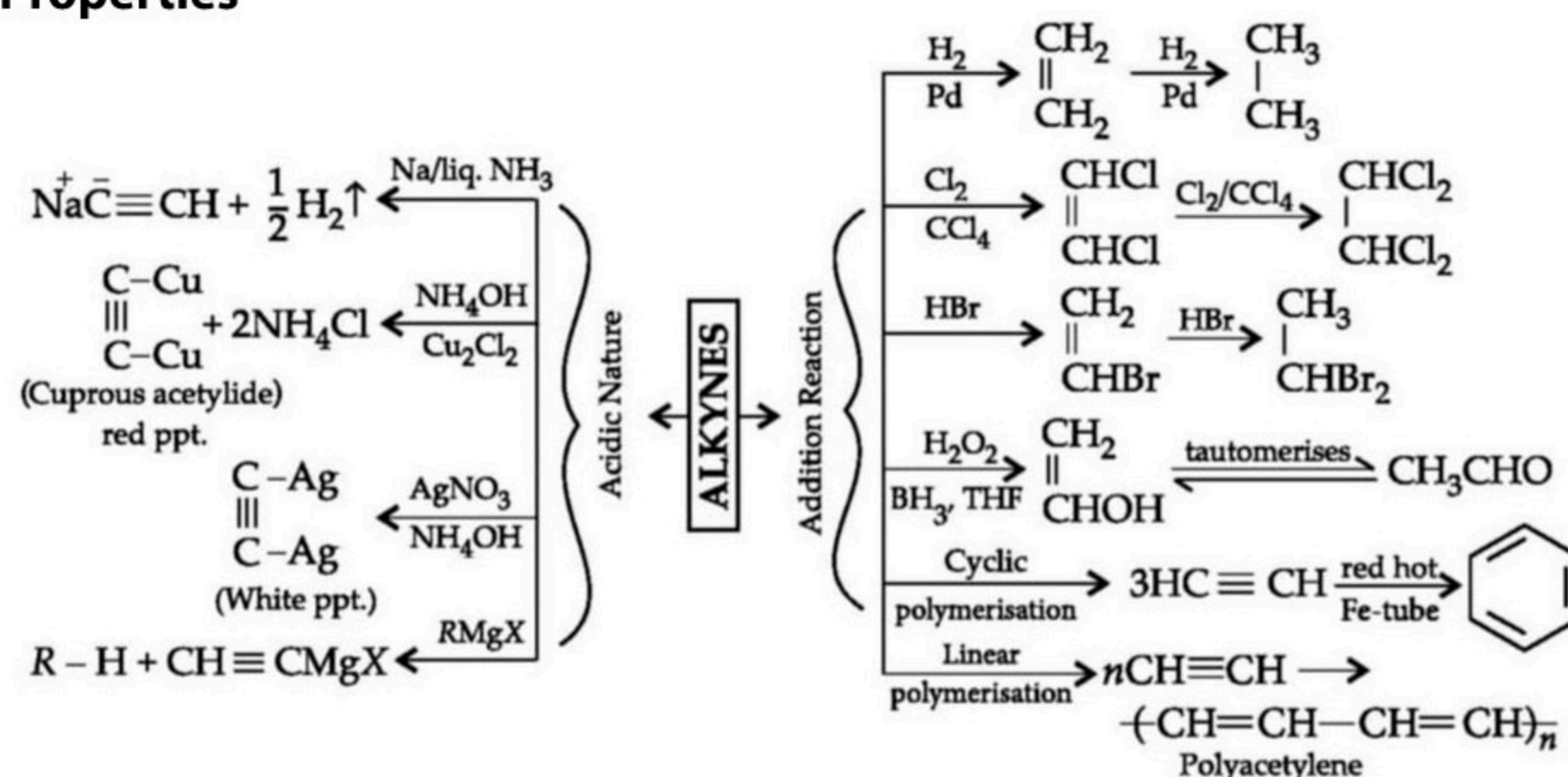
## Isomerism

- Ethyne does not show any type of isomerism. Alkynes form chain, position, functional and ring chain isomerism.

## Methods of Preparation

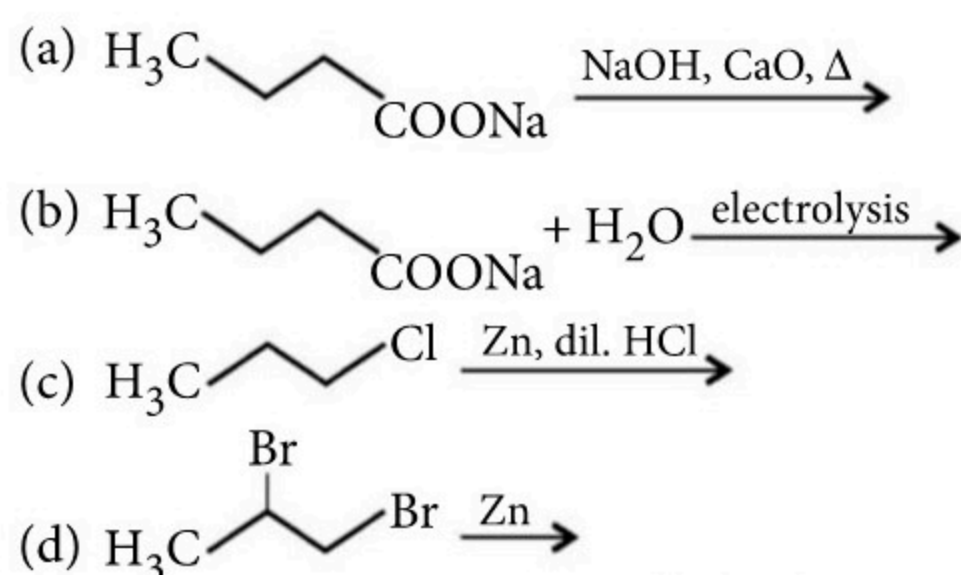


## Chemical Properties

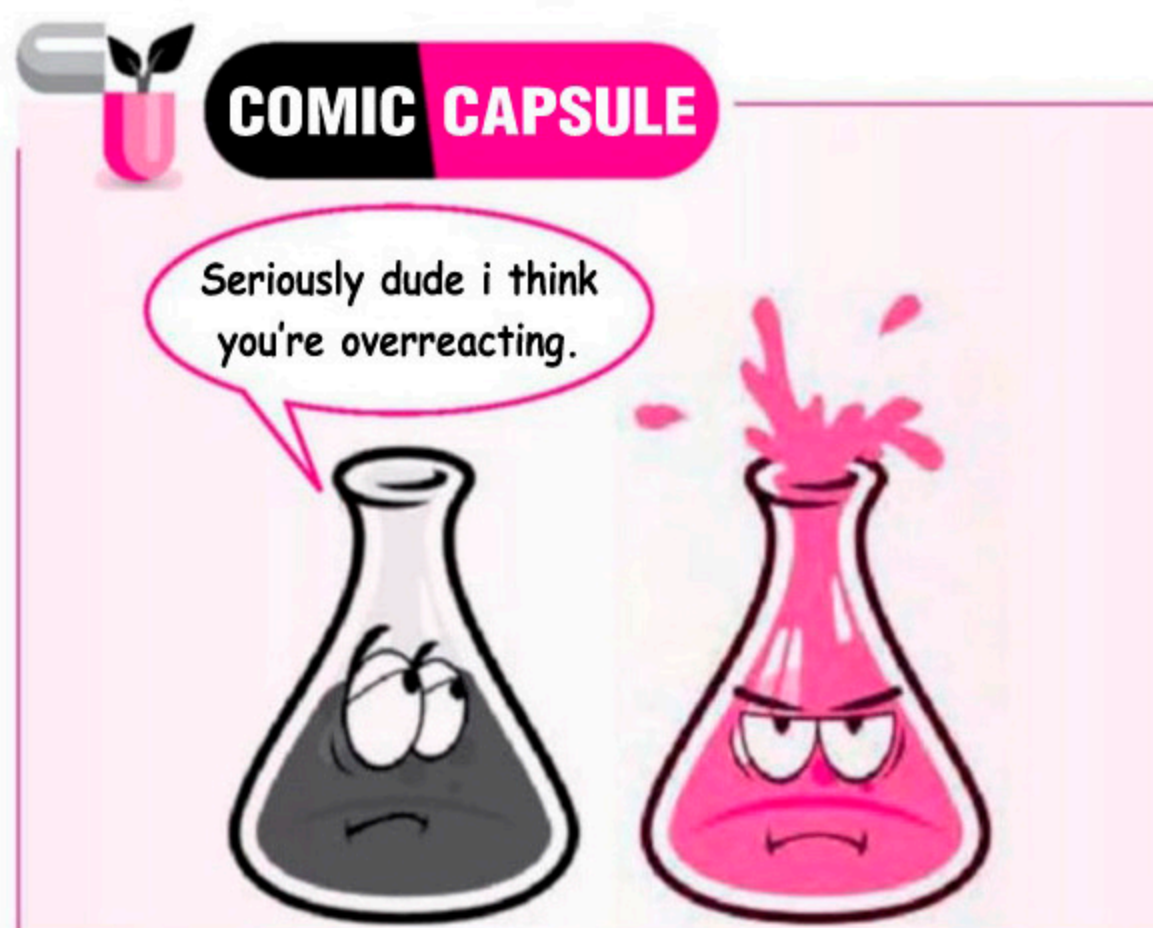


## PEEP INTO PREVIOUS YEARS

1. Which of the following reactions produce(s) propane as a major product?

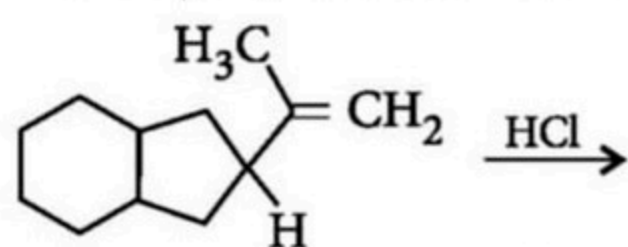


(JEE Advanced 2019)





2. The major product of the following reaction is



- (a)
- (b)
- (c)
- (d)

(JEE Main 2019)

3. An alkene A on reaction with  $O_3$  and  $Zn-H_2O$  gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene A gives B as the major product. The structure of product B is

- (a)
- (b)
- (c)
- (d)

(NEET 2019)

4. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is

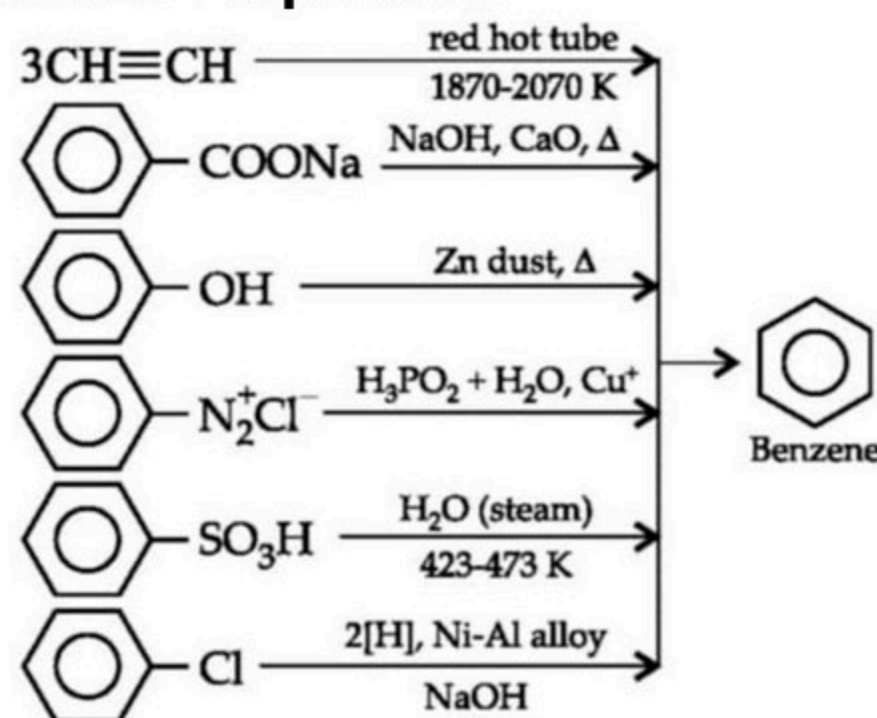
- (a)  $CH \equiv CH$  (b)  $CH_2 = CH_2$   
(c)  $CH_3 - CH_3$  (d)  $CH_4$

(NEET 2018)

## AROMATIC HYDROCARBONS

- Hydrocarbons which contain one or more benzene rings either fused or isolated in their molecules are called aromatic hydrocarbons or arenes.

### Methods of Preparation



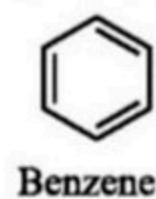
### Physical Properties

- Aromatic hydrocarbons are non-polar molecules.
- These are colourless liquids or solids with a characteristic aroma.
- These are immiscible with water but miscible in organic solvents and burn with sooty flame.

### Huckel Rule of Aromaticity

- Huckel rule of aromaticity is applied to all the ring systems whether they have benzene ring or not and possess the following characteristics :

- Planarity
- Complete delocalisation of  $\pi$ -electrons in the ring.
- Presence of  $(4n + 2)\pi$ -electrons in the ring where  $n = 0, 1, 2, 3, \dots$  etc. e.g.,



Benzene



Cyclopentadienyl anion

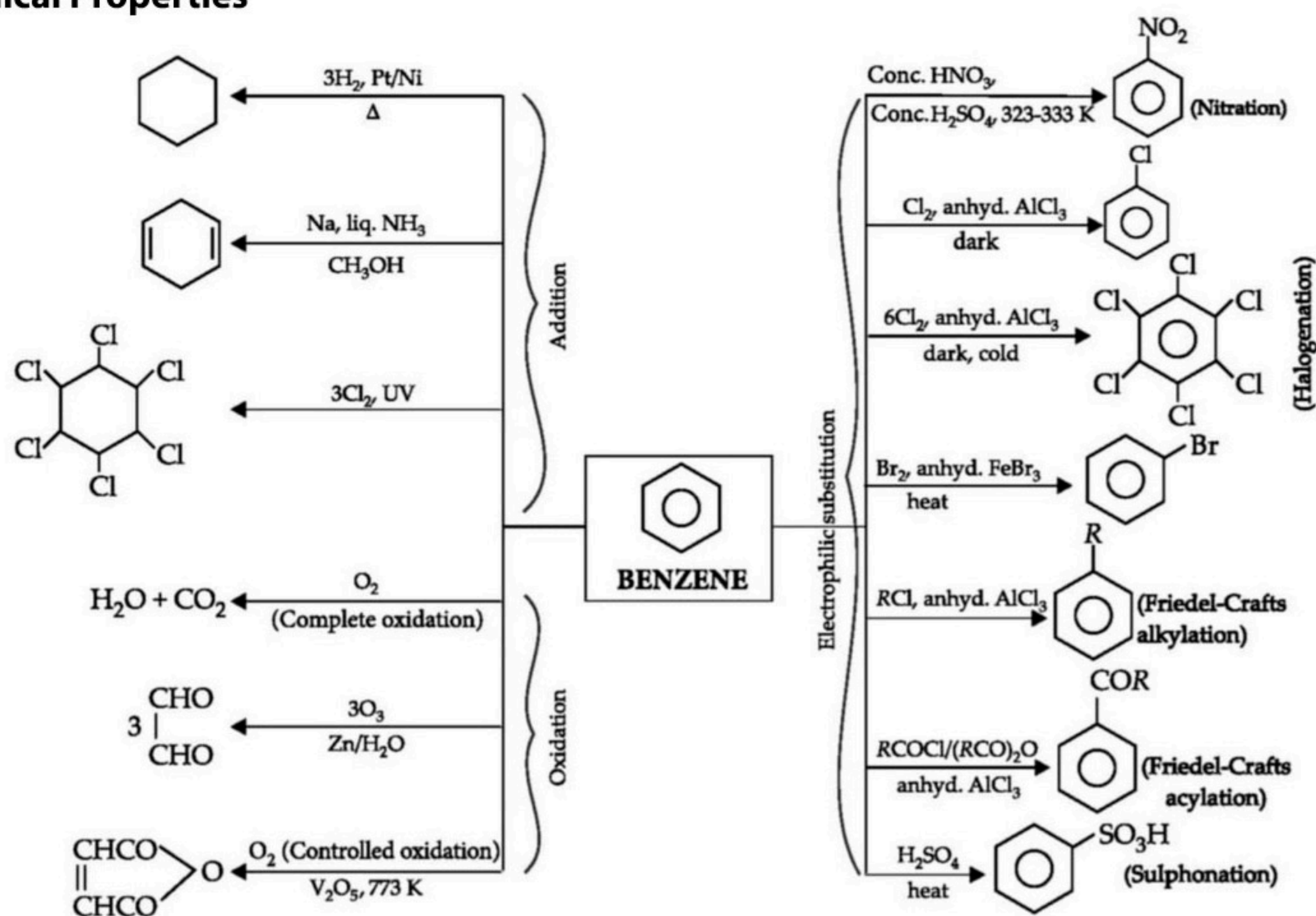


Cycloheptatrienyl cation

- Aromatic :**
  - Cyclic, planar molecule
  - Complete delocalisation of  $\pi$  electrons
  - Follow Huckel rule  $(4n + 2) \pi e^-$ s
- Anti-aromatic :**
  - Cyclic, planar molecule
  - Complete delocalisation of  $\pi$  electrons
  - Follow  $4n \pi e^-$ s
- Non-aromatic :**
  - Either non-cyclic, non-planar
  - No delocalisation of  $\pi$  electrons.
  - May or may not follow Huckel rule.

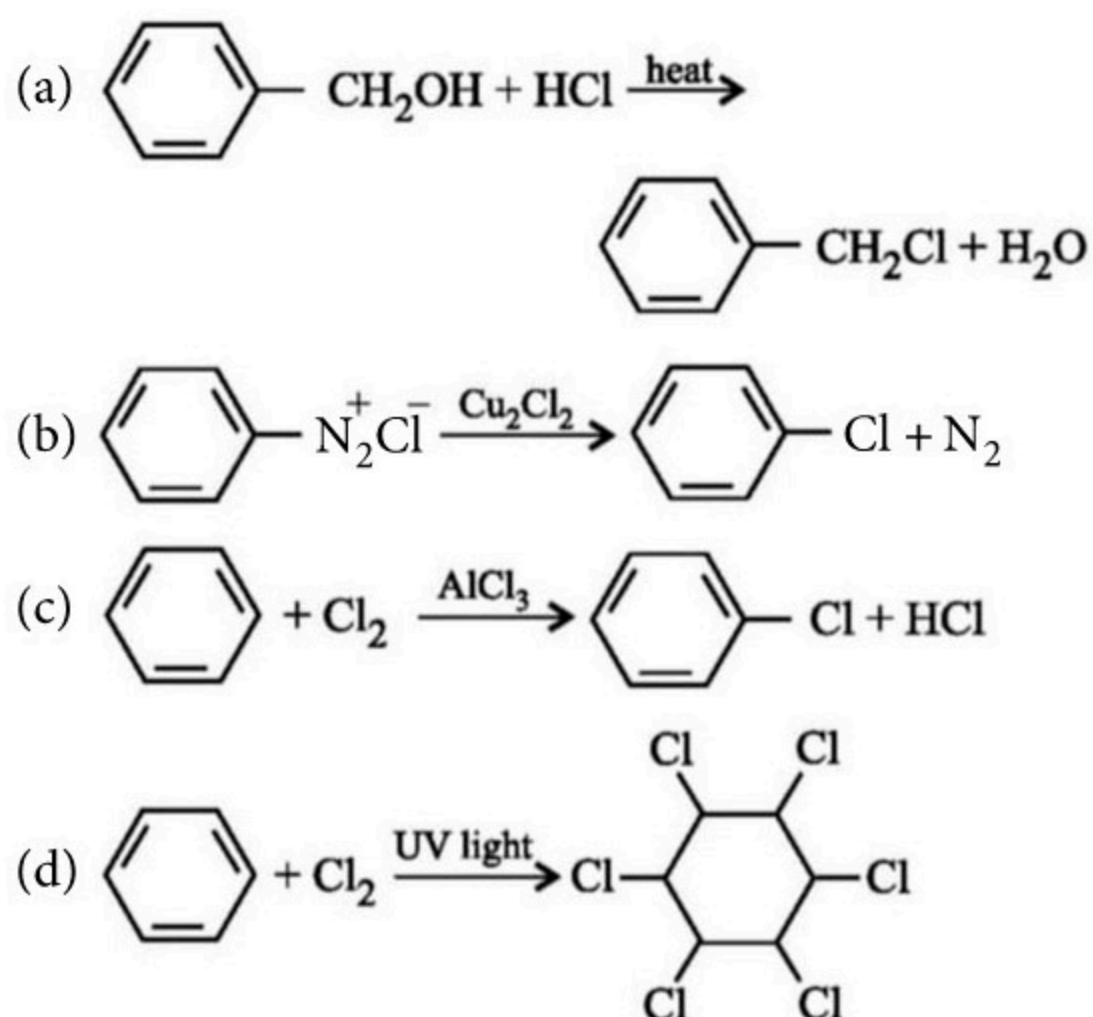


## Chemical Properties



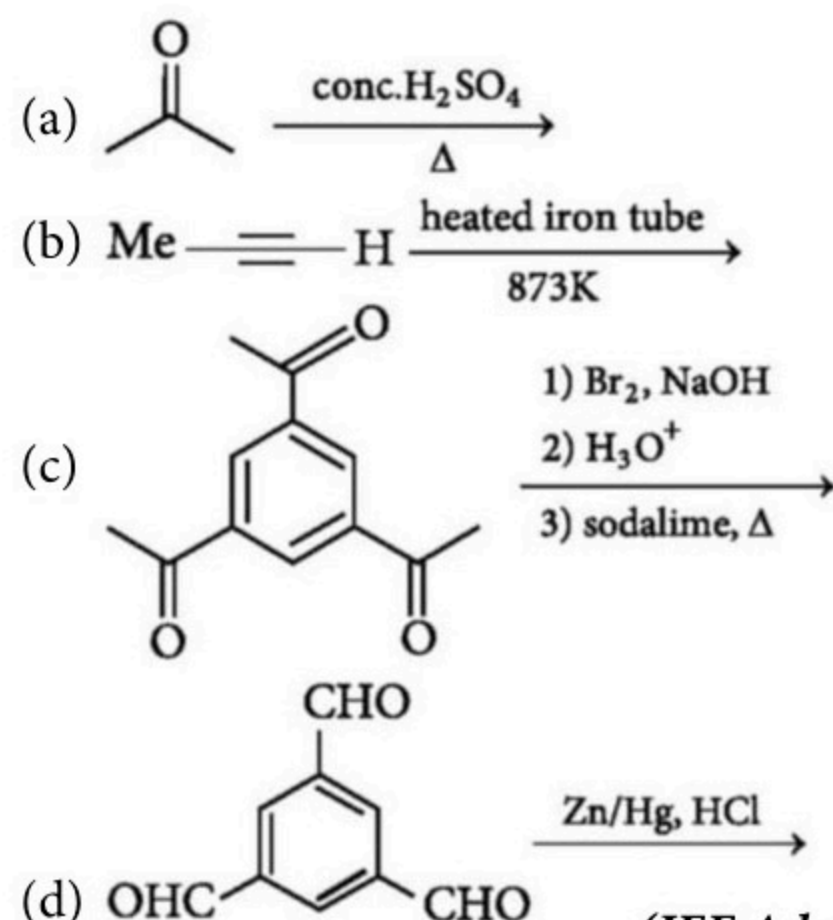
### PEEP INTO PREVIOUS YEARS

5. Among the following the reaction that proceeds through an electrophilic substitution is



(NEET 2019)

6. The reaction(s) leading to the formation of 1,3,5-trimethylbenzene is (are)



(JEE Advanced 2018)

### POINTS FOR EXTRA SCORING

- The number of degree of unsaturation in a hydrocarbon is given by:  $\frac{2n_1 + 2 - n_2}{2}$ .
- Addition of symmetrical reagents over symmetrical alkenes can be generalised as
  - *cis*-alkene + syn addition  $\rightarrow$  meso product
  - *trans*-alkene + syn addition  $\rightarrow$  racemic product
  - *cis*-alkene + anti addition  $\rightarrow$  racemic product
  - *trans*-alkene + anti addition  $\rightarrow$  meso product.



## Environmental Chemistry

- Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

### ENVIRONMENTAL POLLUTION

- Any undesirable change in the surrounding which has harmful effects on living beings is called environmental pollution. A substance which causes pollution, is known as pollutant.
- Primary and secondary pollutants :** Primary pollutants are those which remain as such in the environment after their formation like NO, SO<sub>2</sub>, NO<sub>2</sub> whereas secondary pollutants are formed from the primary pollutants like PAN (Peroxyacetyl nitrate).

### AIR POLLUTION

- It is the addition of undesirable materials into the atmosphere either due to natural phenomena or due to human activity on the earth which adversely affect the quality of the air and hence, affects the life on the earth.

### Greenhouse Effect and Global Warming

- The retention of heat by the earth and atmosphere from the sun and its prevention to escape into the outer space is known as greenhouse effect.
  - Greenhouse gases such as CO<sub>2</sub>, ozone, methane, chlorofluorocarbon compounds and water vapour form a thick cover around the earth which prevents the IR rays emitted by the earth to escape.
  - It gradually leads to increase in temperature of atmosphere. This phenomenon of increasing earth's temperature is called global warming.

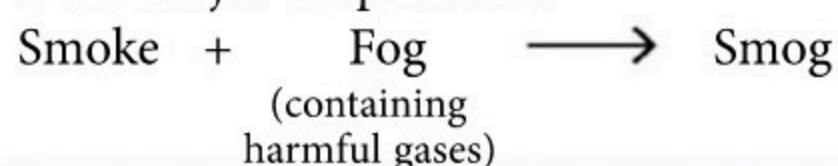
### Acid Rain

- Rain water normally has a pH of 5.6 due to dissolution of CO<sub>2</sub> present in the atmosphere.  

$$\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$$
- When this pH falls below 5.6, the rain water becomes acidic. The main gases responsible for acid rain are SO<sub>2</sub> and NO<sub>2</sub>.
- Harmful Effects of Acid Rain**
  - Damage to buildings and statues made of marble, limestone, slate, etc.
  - It is toxic to vegetation and aquatic life.
  - It corrodes water pipes resulting in the leaching of the heavy metals such as Fe, Pb and Cu into the drinking water which have toxic effects.

### Smog

- The word smog is derived from smoke and fog. It is the major air pollutant.



| Classical smog                   | Photochemical smog                |
|----------------------------------|-----------------------------------|
| Also called as London smog.      | Also called as Los Angeles smog.  |
| Formed due to oxides of sulphur. | Formed due to oxides of nitrogen. |
| Contains primary pollutants.     | Contains secondary pollutants.    |
| It is reducing in nature.        | It is oxidising in nature.        |

### Stratospheric Pollution (Ozone depletion)

- Ozone (O<sub>3</sub>) present in the stratosphere prevents about 99.5% of UV radiations from reaching the earth's surface and thereby protecting humans and other animals from its harmful effects.
- A dynamic equilibrium exists between the production and decomposition of ozone molecules.  

$$\text{O}_{2(g)} \xrightarrow{\text{UV}} \text{O}_{(g)} + \text{O}_{(g)}; \text{O}_{(g)} + \text{O}_{2(g)} \xrightleftharpoons{\text{UV}} \text{O}_{3(g)}$$
- The main reason of ozone layer depletion is the release of chlorofluorocarbon compounds (CFCs), also known as freons.

### WATER POLLUTION

- Water pollution may be defined as any change in its physical, chemical or biological properties or contamination with foreign materials that can adversely affect human beings or reduce its utility for the intended use.

### Effects of Water Pollution

- High concentrations of fluoride are poisonous and are harmful to bones and teeth at levels over 10 ppm.
- Excess nitrate in drinking water can lead to blue baby syndrome.
- Excess sulphate (> 500 ppm) have a laxative effect.

### Biochemical Oxygen Demand (BOD)

- The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called BOD. It is a measure of the amount of organic material in the water.



## Chemical Oxygen Demand (COD)

- It is the measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals.

## Eutrophication

- The process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

## SOIL POLLUTION

- Soil pollution is the addition of such chemical substances (in an indefinite proportion) which deteriorates the quality, texture and mineral content of the soil and disturbs the biological balance of the organisms in it and has lethal effect on the plant growth.
- Some major soil pollutants and their sources are :

| Pollutants             | Major sources  |
|------------------------|--|
| Industrial wastes      | Waste products from paper, sugar, chemical industries dumped into the soil.                |
| Agricultural wastes    | Chemicals such as fertilizers, pesticides, etc. used for killing insects, fungi and weeds. |
| Radioactive pollutants | Dumping of nuclear wastes into the soil.   |

## CONTROL OF ENVIRONMENTAL POLLUTION

- Waste management :** Environmental pollution can be controlled to a certain extent by managing the waste disposal in a proper way.
- Recycling :** A large amount of disposed waste material can be reused by recycling the waste. Thus, it reduces the land fill and converts waste into usable forms.
- Sewage treatment :** It can be done by :
  - Incineration
  - Digestion
  - Dumping

## GREEN CHEMISTRY

- Green chemistry is a process that would bring about minimum pollution or deterioration to the environment.

- It is a chemical philosophy encouraging the design of products and processes that reduces or eliminates the use and generation of hazardous substances.
- Green chemistry in day-to-day life :
  - Dry cleaning of clothes
  - Bleaching of paper
  - To clean turbid water

## PEEP INTO PREVIOUS YEARS

7. The compound that is not a common component of photochemical smog is
- (a)  $\text{H}_3\text{C}-\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{C}-\text{OONO}_2$
- (b)  $\text{CH}_2=\text{CHCHO}$
- (c)  $\text{CF}_2\text{Cl}_2$  (d)  $\text{O}_3$  (JEE Main 2019)
8. Among the following, the one that is not a greenhouse gas is
- (a) sulphur dioxide (b) nitrous oxide
- (c) methane (d) ozone. (NEET 2019)
9. Water filled in two glasses A and B have BOD values of 10 and 20, respectively. The correct statement regarding them, is
- (a) A is suitable for drinking, whereas B is not
- (b) A is more polluted than B
- (c) both A and B are suitable for drinking
- (d) B is more polluted than A. (JEE Main 2019)
10. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?
- (a)  $\text{N}_2\text{O}_5$  (b)  $\text{NO}_2$
- (c)  $\text{N}_2\text{O}$  (d)  $\text{NO}$  (NEET 2018)

## POINTS FOR EXTRA SCORING

- The carboxyhaemoglobin is about 300 times more stable than the oxyhaemoglobin complex.
- Clean water has a BOD value of less than 5 ppm whereas highly polluted river water may have BOD value of 17 ppm or more.
- pH of drinking water should be between 5.5 and 9.5.
- Excess nitrate in drinking water lead to methemoglobinemia (blue-baby syndrome).
- International standards for drinking water :** Fluorides < 1 ppm, Lead < 50 ppb, Sulphates < 500 ppm, Nitrates < 50 ppm.

## Answer Key For Peep Into Previous Years

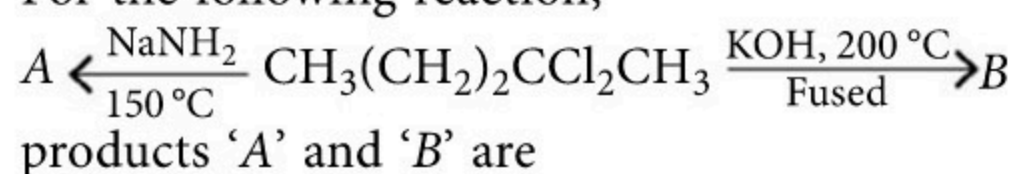
1. (a, c) 2. (b) 3. (d) 4. (d) 5. (c) 6. (a, b, d)
7. (c) 8. (a) 9. (d) 10. (a)





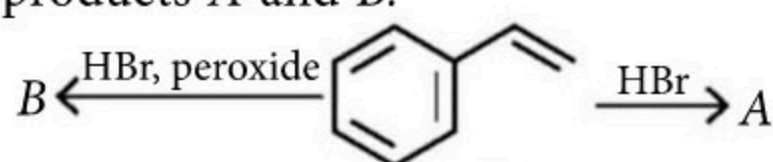
# WRAP it up!

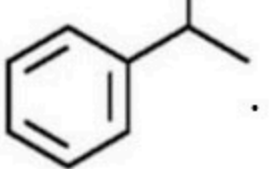
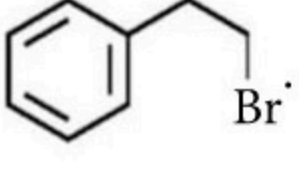
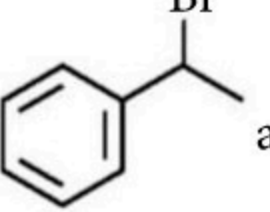
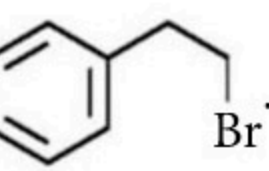
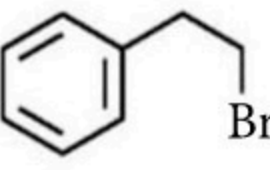
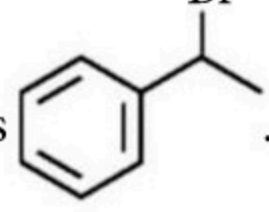
1. For the following reaction,



products 'A' and 'B' are

- (a) same,  $\text{CH}_3\text{CH}_2 - \text{C} \equiv \text{C} - \text{CH}_3$   
 (b) A :  $\text{CH}_3 - \text{CH}_2 - \text{C} \equiv \text{C} - \text{CH}_3$   
 B :  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$   
 (c) same,  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$   
 (d) A :  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$   
 B :  $\text{CH}_3 - \text{CH}_2 - \text{C} \equiv \text{C} - \text{CH}_3$
2. Observe the following reactions and predict the major products A and B.



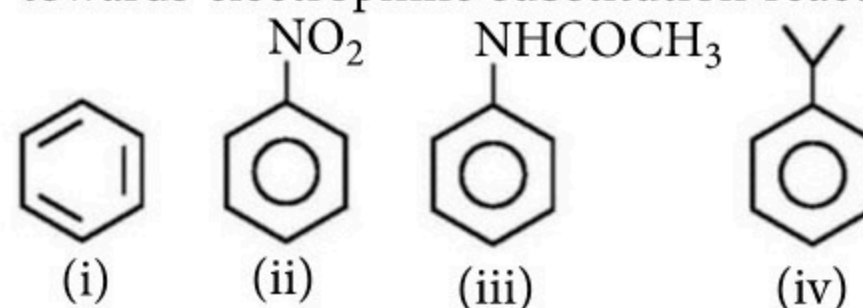
- (a) A and B both are 
- (b) A and B both are 
- (c) A is  and B is 
- (d) A is  and B is 

3. The product obtained *via* oxymercuration ( $\text{HgSO}_4 + \text{H}_2\text{SO}_4$ ) of 1-butyne would be

- (a)  $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3$   
 (b)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CHO} + \text{HCHO}$   
 (d)  $\text{CH}_3\text{CH}_2\text{COOH} + \text{HCOOH}$

4. Carbon monoxide is naturally produced by oxidation of X, a gas present in swamp area while it can be produced by Y of fuels containing carbon.
- (a) X =  $\text{CO}_2$ , Y = complete combustion  
 (b) X =  $\text{CH}_4$ , Y = incomplete combustion  
 (c) X = C, Y = oxidation  
 (d) X =  $\text{CH}_4$ , Y = complete combustion

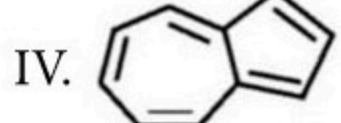
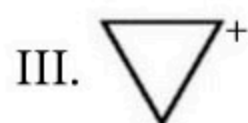
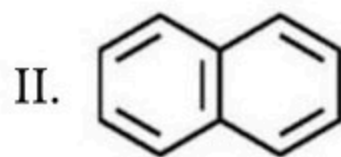
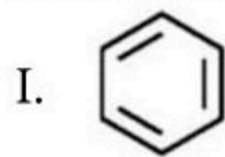
5. The correct order for the following compounds towards electrophilic substitution reaction is



- (a) (iv) > (iii) > (ii) > (i) (b) (i) > (ii) > (iii) > (iv)  
 (c) (iv) > (iii) > (i) > (ii) (d) (iii) > (iv) > (i) > (ii)
6. Consider the reaction,  
 $\text{RH} + (\text{CH}_3)_3\text{COCl} \xrightarrow{\text{Heat}}$   
 The expected major products are
- (a)  $(\text{CH}_3)_3\text{COH}$  and  $\text{RCl}$   
 (b)  $\text{ROCl}$  and  $(\text{CH}_3)_3\text{CH}$   
 (c)  $\text{ROH}$  and  $(\text{CH}_3)_3\text{CCl}$   
 (d)  $(\text{CH}_3)_3\text{COR}$  and  $\text{HCl}$
7. A body which allows the short wavelength incoming solar radiations to enter in but does not allow long wavelength outgoing IR radiations to escape out is called
- (a) global warming (b) greenhouse  
 (c) ionosphere (d) stratosphere.
8. Which of the following is the best sequence to convert benzene into 3-chloroaniline?
- (a) Nitration, chlorination, reduction  
 (b) Nitration, reduction, chlorination  
 (c) Nitration, chlorination, sulphonation  
 (d) Chlorination, nitration, reduction
9. Eutrophication is due to
- (a)  $\text{SO}_4^{2-}$  ions present in water  
 (b)  $\text{NaCl}$  present in water  
 (c)  $\text{PO}_4^{3-}$  ions present in water  
 (d) heavy metals present in water.
10. An alkane with mol. mass = 86 on bromination gives only two monobromo derivatives (excluding stereoisomers). The alkane is
- (a)  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_3$   
 (b)  $(\text{CH}_3)_3\text{C} - \text{CH}_2\text{CH}_3$   
 (c)  $(\text{CH}_3)_2\text{CH} - \text{CH}(\text{CH}_3)_2$   
 (d)  $(\text{CH}_3)_4\text{C}$



11. Which of the following chemical systems is/are non-aromatic?



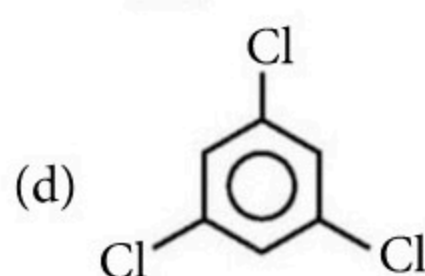
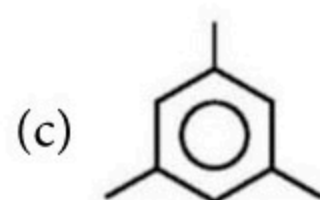
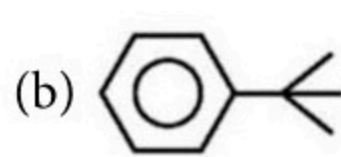
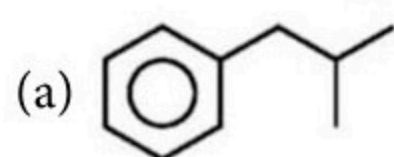
- (a) Only III (b) Only IV  
(c) Only II and IV (d) None of these
12. B.O.D values of four samples of water A, B, C and D are given below :

A. 160 ppm B. 35 ppm  
C. 180 ppm D. 25 ppm

The decreasing order of extent of pollution in water is

- (a)  $C > A > D > B$  (b)  $D > B > A > C$   
(c)  $C > A > B > D$  (d)  $D > A > B > C$

13.  $\xrightarrow{\text{AlCl}_3}$  X, compound X is



14. Which of the following is not an example of green chemistry?

- (a) Catalytic dehydrogenation of the diethanolamine without using cyanide and formaldehyde.  
(b) Replacement of CFCs by  $\text{CO}_2$  as blowing agent in the manufacture of polystyrene foam sheets.  
(c) Reacting methylamine and phosgene to produce methyl isocyanate  
(d) Replacement of organotins by 'sea-nine' as anti-fouling compound in sea marines.

15. Which of the following reagents cannot be used to distinguish between propene and propyne?

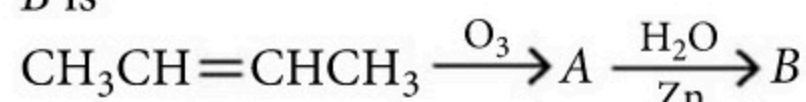
- (a) Grignard reagent  
(b) Ammoniacal  $\text{AgNO}_3$   
(c) Lucas reagent  
(d) Ammoniacal  $\text{Cu}_2\text{Cl}_2$

16. Which of the following statements is false?

- (a) Over Antarctica, the depletion of ozone layer is due to the formation of chlorine nitrate.  
(b) Both  $\text{O}_3$  and  $\text{NO}_2$  reacts with unburnt hydrocarbons in the polluted air to give PAN.

- (c) Classical smog consists of a mixture of smog, fog and sulphur dioxide.  
(d) Gaseous pollutants consist of oxide of carbon, sulphur and nitrogen along with dust, fumes, smoke, smog, etc.

17. In the following sequence of reactions, the compound B is



- (a)  $\text{CH}_3\text{CHO}$  (b)  $\text{CH}_3\text{CH}_2\text{CHO}$   
(c)  $\text{CH}_3\text{COCH}_3$  (d)  $\text{CH}_3\text{CH}_2\text{COCH}_3$

18. The chemicals and the reaction conditions required for the preparation of ethane are

- (a)  $\text{C}_2\text{H}_5\text{I}$ ,  $\text{Zn} - \text{Cu}$ ,  $\text{C}_2\text{H}_5\text{OH}$   
(b)  $\text{CH}_3\text{Cl}$ ,  $\text{Na}$ ,  $\text{H}_2\text{O}$   
(c)  $\text{KOOC} - \text{CH}=\text{CH} - \text{COOK}$ , electrolysis  
(d)  $\text{CH}_3\text{COONa}$ ,  $\text{NaOH}$ ,  $\text{CaO}$ ,  $\Delta$

19. The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is

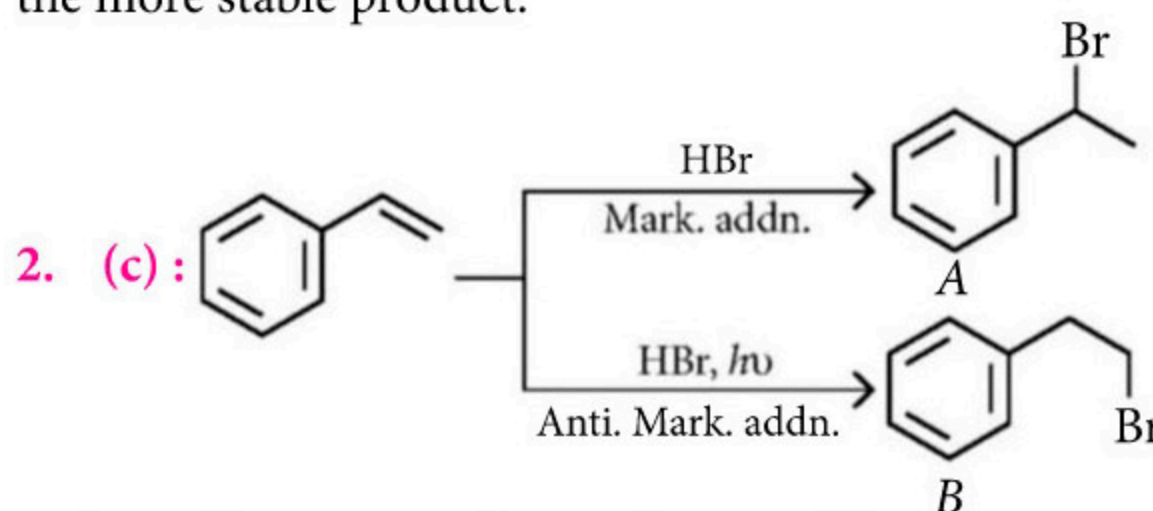
- (a) 5 (b) 4 (c) 3 (d) 2

20. Identify the incorrect statement among the following.

- (a) Oxides of nitrogen in the atmosphere can cause the depletion of ozone layer.  
(b) Ozone absorbs the intense ultraviolet radiations of the sun.  
(c) Depletion of ozone layer is because of its chemical reactions with chlorofluorocarbons  
(d) Ozone absorbs infrared radiations.

## SOLUTIONS

1. (d):  $\text{NaNH}_2$  is a strong base, that gives kinetic product, terminal alkyne as the major product while KOH gives thermodynamic product internal alkyne, as the more stable product.



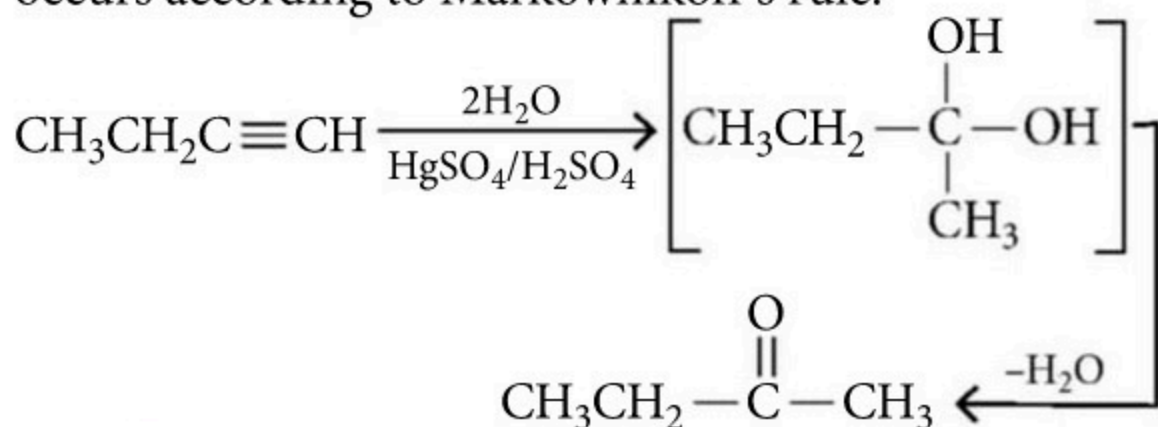
## UNSCRAMBLED WORDS

JANUARY 2020

- |               |                 |
|---------------|-----------------|
| 1-g-ADIPOCERE | 2-a-AMANITINS   |
| 3-e-BIXIN     | 4-h-CARCEPLEXES |
| 5-d-TRIFLATE  | 6-f-TETRAZOLES  |
| 7-b-SUBERANE  | 8-c-KRILIUM     |



3. (a): Hydration of alkynes via oxymercuration occurs according to Markownikoff's rule.

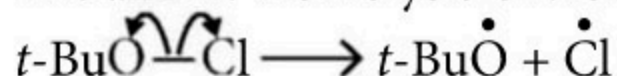


4. (b)

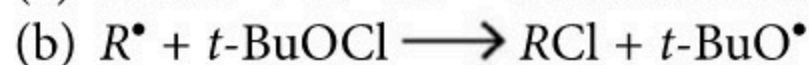
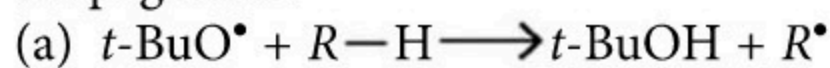
5. (d):  $-\text{NHCOCH}_3$  is more activating than isopropyl group. Therefore, option (d) is correct.

6. (a): Alkanes are monochlorinated with *t*-butyl hypochlorite, *t*-BuOCl.

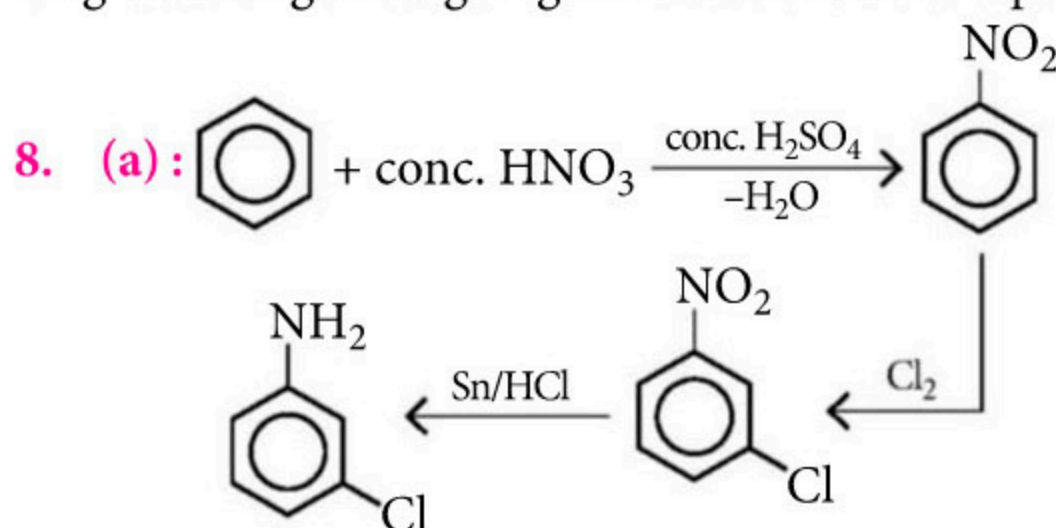
Initiation: Homolysis of *t*-butyl hypochlorite.



Propagation:



7. (b): A greenhouse allows the short wavelength incoming solar radiations to enter in but does not allow long wavelength outgoing IR radiations to escape out.

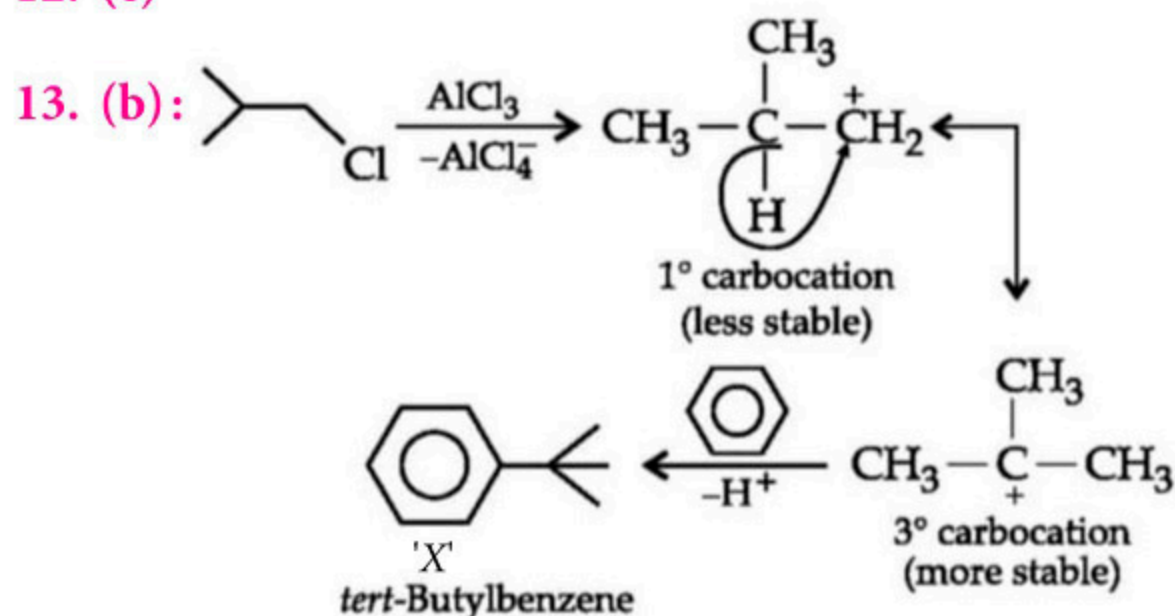


9. (c)

10. (c): The alkane with mol. mass 86 is hexane ( $\text{C}_6\text{H}_{14}$ ), 2,3-dimethylbutane, i.e., option (c) has only two types of hydrogens and hence forms two monobromo derivatives.

11. (a): All the species except III are planar and possess  $(4n + 2)$   $\pi$  electrons which are completely delocalized.

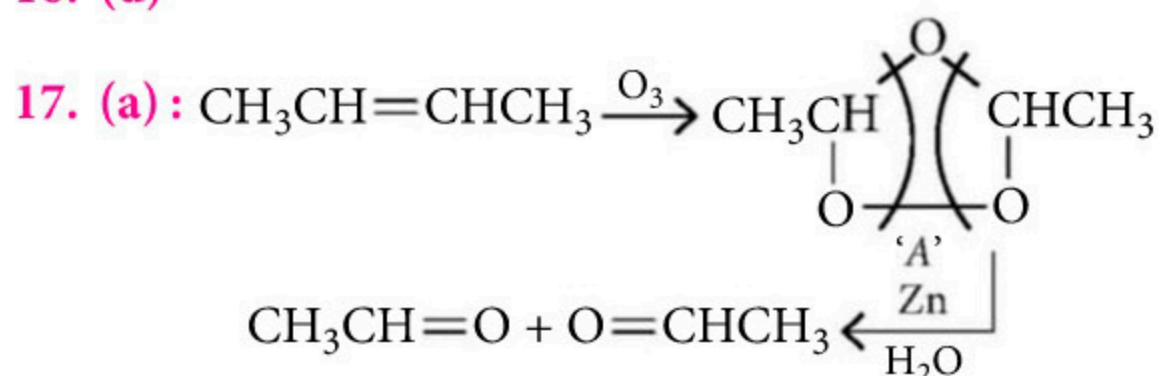
12. (c)



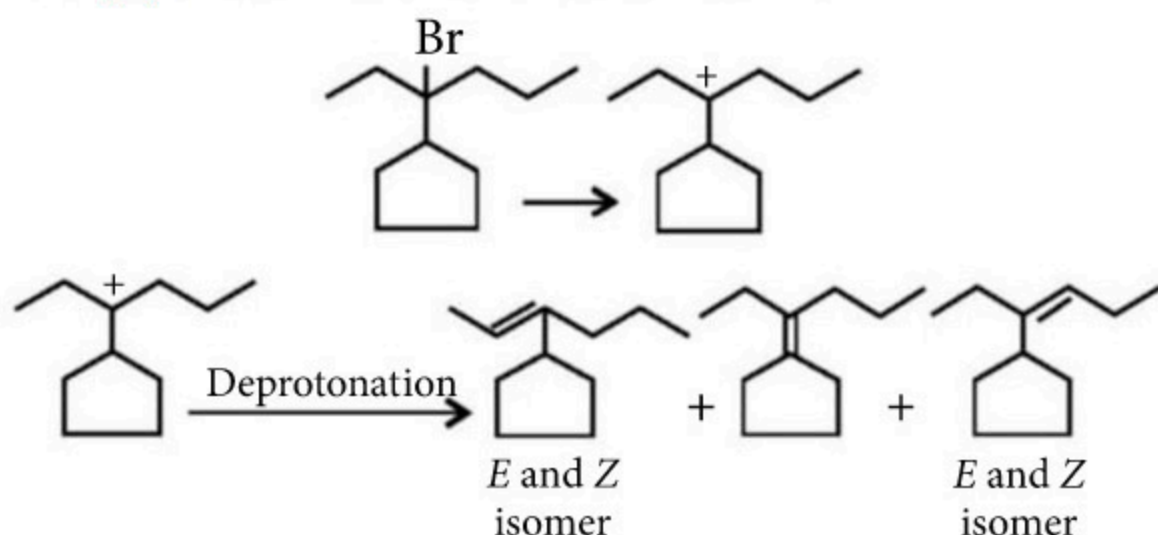
14. (c)

15. (c): Propyne has acidic hydrogen but propene does not. Therefore, propyne reacts with Grignard reagent to evolve alkane (RH), with  $\text{AgNO}_3$  to give white ppt. of silver propynide and with ammoniacal solution of  $\text{Cu}_2\text{Cl}_2$  to form red ppt. of copper propynide.

16. (d)



19. (a): Total no. of alkenes will be = 5



20. (d): Ozone does not absorb infrared radiation at all. It absorbs UV radiation coming from sun in the upper atmosphere and acts as a umbrella thus protecting human being living on earth.

### EXAM CORNER 2020

| Exam           | Date   |
|----------------|--|
| WB JEE         | 2 <sup>nd</sup> February   |
| JEE Main II    | 05 <sup>th</sup> , 07 <sup>th</sup> to 09 <sup>th</sup> & 11 <sup>th</sup> April |
| VITEEE         | 13 <sup>th</sup> to 19 <sup>th</sup> April                                       |
| SRMJEEE        | 12 <sup>th</sup> to 20 <sup>th</sup> April                                       |
| J & K CET      | 19 <sup>th</sup> April   |
| Kerala PET     | 20 <sup>th</sup> & 21 <sup>st</sup> April  |
| Karnataka CET  | 22 <sup>nd</sup> & 23 <sup>rd</sup> April  |
| NEET           | 3 <sup>rd</sup> May  |
| COMEDK (Engg.) | 10 <sup>th</sup> May   |
| AMU (Engg.)    | 10 <sup>th</sup> May   |
| BITSAT         | 16 <sup>th</sup> to 25 <sup>th</sup> May   |
| MHT CET        | 16 <sup>th</sup> to 20 <sup>th</sup> May   |
| JEE Advanced   | 17 <sup>th</sup> May   |





# CBSE

## warm-up!

CLASS-XI

Practice questions for CBSE Exams as per the latest pattern  
and marking scheme issued by CBSE for the academic session 2019-20.

## Practice Paper 2020

Time Allowed : 3 hours  
Maximum Marks : 70

### GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
- Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
- Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
- Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

### SECTION - A

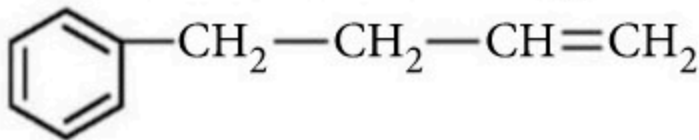
Read the given passage and answer the questions 1 to 5 that follow :

When an acid reacts with a base to form salt and water, the process is called neutralisation. The indicator used in the titration depends upon the nature of the acid and the nature of the base. The reverse of neutralisation is salt hydrolysis. The salt of a weak acid or a weak base does not hydrolyse completely. The extent of hydrolysis is expressed in terms of 'degree of hydrolysis'. As it is an equilibrium process, the equilibrium constant is called hydrolysis constant ( $K_h$ ). Knowing the ionisation constants of the weak acid and weak base involved, the pH of the salt solution can be calculated for any particular concentration.

- Identify the indicator used to titrate  $\text{Na}_2\text{CO}_3$  solution with HCl.
- Why are strong acids generally used as standard solutions in acid-base titrations?

- The percentage hydrolysis of M/160 KCN solution at  $25^\circ\text{C}$  will be (For KCN,  $K_a = 6.4 \times 10^{-10}$ )
- The pH of 1 M ammonium acetate solution will be (Given  $\text{p}K_a$  of acetic acid = 4.76 and  $\text{p}K_b$  of  $\text{NH}_4\text{OH}$  = 4.75)
- The solubility product of silver chloride is  $1.8 \times 10^{-10}$  at 298 K. The solubility of AgCl in 0.01 M HCl solution in  $\text{mol/dm}^3$  is

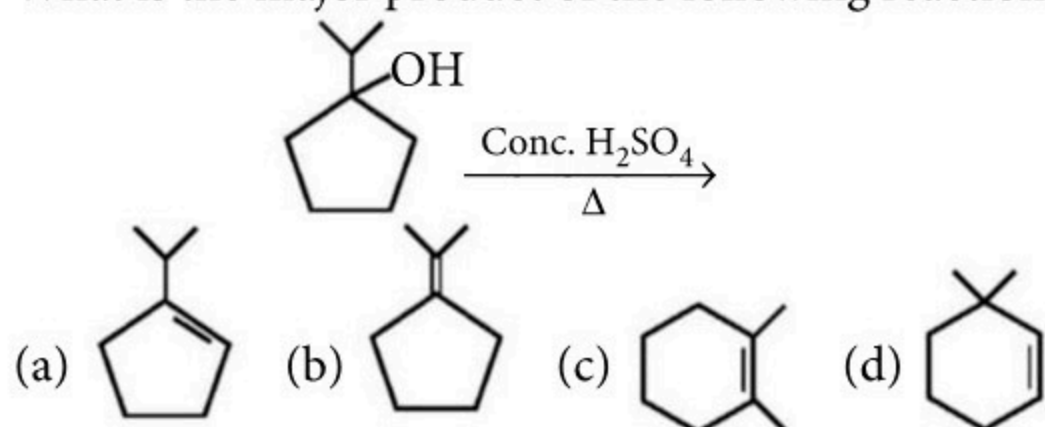
Questions 6 to 10 are one word answers :

- Which quantum number tells us about the shapes of sub-shells?
- Write the IUPAC name for the element with atomic number 106.
- What is the binding force between gas molecule under ordinary conditions of temperature and pressure?
- Write IUPAC name of the organic compound :  

- Name the amorphous form of silica.



**Questions 11 to 15 are multiple choice questions :**

11. In Lassaigne's test for sulphur in the organic compound with sodium nitroprusside solution the purple colour formed is due to  
 (a)  $\text{Na}_4[\text{Fe}(\text{CN})_5(\text{NOS})]$  (b)  $\text{Na}_3[\text{Fe}(\text{CN})_5\text{S}]$   
 (c)  $\text{Na}_3[\text{Fe}(\text{CN})_5(\text{NOS})]$  (d)  $\text{Na}_3[\text{Fe}(\text{CN})_6]$
12. 200 g of hydrogen reacts with nitrogen according to equation,  $3\text{H}_{2(g)} + \text{N}_{2(g)} \rightarrow 2\text{NH}_{3(g)}$ , to produce  
 (a) 11.322 g of ammonia (b) 113.22 g of ammonia  
 (c) 1133.33 g of ammonia (d) 11322 g of ammonia.
13. For the species  $\text{NO}$ ,  $\text{NO}^+$  and  $\text{NO}^-$ , the correct order of bond lengths is  
 (a)  $\text{NO}^+ < \text{NO} < \text{NO}^-$   
 (b)  $\text{NO}^+ < \text{NO}^- < \text{NO}$   
 (c)  $\text{NO} < \text{NO}^- < \text{NO}^+$   
 (d)  $\text{NO} < \text{NO}^+ < \text{NO}^-$
14. What is the major product of the following reaction?



15. Which of the following alkali metals gives hydrated salts?  
 (a) Li (b) Na (c) K (d) Cs

**Questions 16 to 20 :**

- (a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.  
 (b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.  
 (c) Assertion is correct, but reason is wrong statement.  
 (d) Assertion is wrong, but reason is correct statement.
16. **Assertion :** Heat added to a system at lower temperature causes greater randomness than when the same quantity of heat is added to it at higher temperature.  
**Reason :** Entropy is a measure of the degree of randomness or disorder in the system.
17. **Assertion :** In the H-atom, the electronic transition  $n_3 \rightarrow n_2$  will emit greater energy than the electronic transition  $n_4 \rightarrow n_3$ .  
**Reason :** The difference between the energies of the adjacent energy levels decreases as we move outward from the nucleus.
18. **Assertion :**  $\text{KClO}_3$  is a strong oxidising agent.  
**Reason :** Decomposition of  $\text{KClO}_3$  will give  $\text{KCl}$  and  $\text{O}_2$  as products.
19. **Assertion :** For greenhouse effect, presence of green plants is essential.

**Reason :**  $\text{CO}_2$  and water vapour present in the atmosphere absorb the re-emitted I.R. radiations from the earth's surface and warm the air.

20. **Assertion :** Melting and boiling points of  $\text{D}_2\text{O}$  are higher than those of ordinary  $\text{H}_2\text{O}$ .

**Reason :**  $\text{D}_2\text{O}$  has lesser degree of association and lower molecular mass than  $\text{H}_2\text{O}$ .

**SECTION - B**

21. Calcium carbonate reacts with aqueous  $\text{HCl}$  to give  $\text{CaCl}_2$  and  $\text{CO}_2$  according to the reaction :  
 $\text{CaCO}_{3(s)} + 2\text{HCl}_{(aq)} \longrightarrow \text{CaCl}_{2(aq)} + \text{CO}_{2(g)} + \text{H}_2\text{O}_{(l)}$   
 What mass of  $\text{CaCO}_3$  is required to react completely with 25 mL of 0.75 M  $\text{HCl}$ ?  
 (At. wt. of  $\text{Ca} = 40$ ,  $\text{C} = 12$ ,  $\text{O} = 16$ ,  $\text{Cl} = 35.5$  u)  
 (NCT 2010, 2012, 2013)
22. The longest wavelength doublet absorption transition is observed at 589 and 589.6 nm. Calculate the frequency of each transition and energy difference between two excited states.
23. Give the name and atomic number of the inert gas in which the total number of  $d$ -electrons is equal to the difference in numbers of total  $p$  and  $s$ -electrons.

**OR**

A, B, C, D and E have the following electronic configuration :

A :  $1s^2, 2s^2, 2p^1$

B :  $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$

C :  $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

D :  $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

E :  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

Which among these belong to the same group in the periodic table? Also classify them in blocks.

24. The enthalpy change for the reaction,  $\text{Zn}_{(s)} + 2\text{H}^+_{(aq)} \longrightarrow \text{Zn}^{2+}_{(aq)} + \text{H}_{2(g)}$ , is  $-154.40 \text{ kJ mol}^{-1}$ . The formation of 2 g of hydrogen expands the system by 22.4 litres at 1 atm pressure. What is the internal energy change of the reaction?
25. At 540 K, 0.10 mol of  $\text{PCl}_5$  are heated in a 8.0 L flask. The pressure of the equilibrium mixture is found to be 1.0 atm. Calculate  $K_p$  and  $K_c$  for the reaction.
26. What causes temporary and permanent hardness of water?  
 (NCERT, KVS 2014, 2019)
27. Write the structure of the alkene which on reductive ozonolysis gives butanone and ethanal.

**OR**

A hydrocarbon A, adds one mole of hydrogen in presence of platinum catalyst to form  $n$ -hexane. When A is oxidised vigorously with  $\text{KMnO}_4$ , a single carboxylic acid containing three carbon atoms is isolated. Give the structure of A and explain.



### SECTION - C

28. A solid mixture weighing 5.00 g containing lead nitrate and sodium nitrate was heated below 600°C until the mass of the residue was constant. If the loss of mass is 28%, find the mass of lead nitrate and sodium nitrate in the mixture. (At wts. of Pb = 207, Na = 23, N = 14, O = 16)

29. Describe the hybridisation scheme in case of  $\text{PCl}_5$ . Why are the axial bonds longer as compared to equatorial bonds? (NCERT, NCT 2008, 2014)

OR

- (a) Use molecular orbital theory to explain why  $\text{Be}_2$  molecule does not exist.  
 (b) (i) Which one has higher bond order  $\text{N}_2$  or  $\text{N}_2^+$ ?  
 (ii) Compare the stability of  $\text{O}_2^+$  and  $\text{O}_2$  on the basis of molecular orbital theory.

30. A 2.0 L container at 25 °C contains 1.25 mol of oxygen and 3.3 mol of carbon.

- (a) What is the initial pressure in the flask?  
 (b) If carbon and oxygen react as completely as possible to form CO, what will be the final pressure in the container?

31. (a) Assign oxidation number to the underlined elements in each of the following species :  
 (i)  $\text{KMnO}_4$  (ii)  $\text{CaO}_2$

(b) Identify the oxidising agent and reducing agent in the following reaction.



(c) What do you understand by disproportionation reaction?

32. Give reasons for the following :

- (i)  $\text{Be}(\text{OH})_2$  dissolves in NaOH but  $\text{Mg}(\text{OH})_2$  does not.  
 (ii) Magnesium oxide is used as a refractory material.  
 (iii) During electrolysis of molten sodium chloride, calcium chloride and potassium fluoride are added.

33. Complete the following reactions :

- (i)  $\text{HC} \equiv \text{CH} \xrightarrow{\text{NaNH}_2, \text{CH}_3\text{Br}} \text{A}$   
 (ii)  $\text{HC} \equiv \text{CH} \xrightarrow{\text{H}_2\text{O}, \text{HgSO}_4/\text{H}_2\text{SO}_4} \text{B}$   
 (iii)  $\text{CH}_3\text{C} \equiv \text{CH} + \text{H}_2 \xrightarrow{\text{Pt/Pd/Ni}} \text{C} \xrightarrow{\text{H}_2} \text{D}$

OR

7-Bromo-1, 3, 5-cycloheptatriene exists as an ion whereas 5-bromo-1, 3-cyclopentadiene does not form an ion even in presence of  $\text{Ag}^+$ . Explain.

34. How can you apply green chemistry for the following:

- (i) To avoid use of halogenated solvents in dry cleaning and that of chlorine in bleaching.  
 (ii) To reduce use of synthetic detergents.  
 (iii) To reduce the consumption of petrol and diesel.

### SECTION - D

35. (a) Write the name of the isomerism shown by the following pairs :

(i) Buta-1,3-diene and but-1-yne ( $\text{C}_4\text{H}_6$ )

(ii) Ethoxybutane and propoxypropane ( $\text{C}_6\text{H}_{14}\text{O}$ )

(b) Why  $3^\circ$  carbocations are more stable than  $1^\circ$  carbocations?

(c) Compare inductive and electromeric effects.

(d) Why  $\text{CCl}_3\text{COOH}$  is a stronger acid than  $(\text{CH}_3)_3\text{CCOOH}$ ?

OR

(a) Why is an organic compound fused with sodium in Lassaigne's test?

(b) What is the Prussian blue coloured compound formed in the Lassaigne's test for confirming the presence of nitrogen in the organic compound?

(c) In a Dumas nitrogen estimation method, 0.30 g of an organic compound gave  $50 \text{ cm}^3$  of  $\text{N}_2$  collected at 300 K and 715 mm Hg pressure. Calculate the percentage composition of nitrogen in the compound. (Vapour pressure of water at 300 K is 15 mm Hg)

36. (i) Explain why the enthalpy changes for the given reactions are not enthalpies of formation of  $\text{CaCO}_3$  and HBr.

(a)  $\text{CaO}_{(s)} + \text{CO}_{2(g)} \rightarrow \text{CaCO}_{3(s)}$ ;  
 $\Delta_r H^\circ = -178.3 \text{ kJ mol}^{-1}$

(b)  $\text{H}_{2(g)} + \text{Br}_{2(g)} \rightarrow 2\text{HBr}_{(g)}$ ;  $\Delta_r H^\circ = -72.8 \text{ kJ mol}^{-1}$

(ii) Calculate the standard enthalpy change ( $\Delta_r H^\circ$ ) and standard internal energy change ( $\Delta_r U^\circ$ ) for the following reaction at 300 K :

$\text{OF}_{2(g)} + \text{H}_2\text{O}_{(g)} \rightarrow \text{O}_{2(g)} + 2\text{HF}_{(g)}$  ; Standard enthalpy of formation ( $\Delta_f H^\circ$ ) of various species are given as :

$\Delta_f H^\circ/\text{kJ mol}^{-1}$  :  $\text{OF}_{2(g)} = 23.0$ ,  $\text{H}_2\text{O}_{(g)} = -241.8$ ,  
 $\text{HF}_{(g)} = -268.6$ ,  $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

OR

Write expression for the work done by 1 mole of the gas in each of the following cases :

(i) For irreversible expansion of the gas from volume  $V_1$  to  $V_2$ .

(ii) For reversible isothermal expansion of the gas from volume  $V_1$  to  $V_2$ .

(iii) For expansion of the gas into an evacuated vessel.

(iv) For reversible isothermal compression of the gas from pressure  $P_1$  to  $P_2$ .

(v) For adiabatic expansion resulting into change of temperature from  $T_1$  to  $T_2$ .

37. (a) What is the molecular formula of inorganic benzene? Why is it called so? Name the two chemicals which when heated together forms inorganic benzene.

(b) What happens (write chemical equations.)

(i) when borax is heated strongly

(ii)  $\text{BF}_3$  reacts with ammonia?



OR

(a) A tetravalent element forms monoxide and dioxide with oxygen. When air is passed over heated element (1273 K), producer gas is obtained. Monoxide of the element is a powerful reducing agent and reduces ferric oxide to iron. Identify the element and write formulas of its monoxide and dioxide. Write chemical equations for the formation of producer gas and reduction of ferric oxide with the monoxide.

(b) (i) Silica is a high melting solid. Explain.  
(ii) Draw the structure of a cyclic silicate,  $(\text{Si}_3\text{O}_9)^{6-}$ .

### SOLUTIONS

1. It is a titration of weak base with strong acid. Hence, methyl orange is used as an indicator.

2. Strong acids can be used to titrate both strong and weak bases.

$$3. \quad h = \sqrt{\frac{K_w}{K_a \cdot c}} = \sqrt{\frac{10^{-14}}{6.4 \times 10^{-10} \times 1/160}} \\ = \sqrt{\frac{10^{-14} \times 160}{6.4 \times 10^{-10}}} = \sqrt{25 \times 10^{-4}} = 5 \times 10^{-2} = 0.05 = 5\%$$

4. For salt of weak acid and weak base,

$$\text{pH} = 7 + \frac{1}{2} [\text{p}K_a - \text{p}K_b] = 7 + \frac{1}{2} (4.76 - 4.75) = 7.005$$

5. In 0.01 M HCl,  $[\text{Cl}^-] \approx 0.01 \text{ M} = 10^{-2} \text{ M}$

$$[\text{Ag}^+] (10^{-2}) = 1.8 \times 10^{-10}$$

or  $[\text{Ag}^+] = 1.8 \times 10^{-8} \text{ M}$  or  $1.8 \times 10^{-8} \text{ mol/dm}^3$

6. Azimuthal quantum number

7. Seaborgium (Sg)

8. van der Waals' forces

9. 4-Phenylbut-1-ene

10. Kieselguhr

11. (a) 12. (a)

13. (a) 14. (c)

15. (a) : Among alkali metal ions,  $\text{Li}^+$  is the smallest. Therefore it has highest charge density and hence attracts water molecules more strongly than any other alkali metal cations.

16. (b) :  $\Delta S$  is related with  $q$  and  $T$  for a reversible reaction as :  $\Delta S = \frac{q_{\text{rev}}}{T}$

17. (a) :  $\because E_2 - E_1 > E_3 - E_2 > E_4 - E_3$  and so on.

18. (b)

19. (d) : For greenhouse effect, presence of  $\text{CO}_2$  and water vapour are essential.

20. (c) :  $\text{D}_2\text{O}$  has higher molecular mass and greater degree of association than  $\text{H}_2\text{O}$  and thus, has higher melting and boiling points.

21. Refer to answer 174 Page no. 36 (MTG CBSE Champion Chemistry Class 11)

22. Refer to answer 64 Page no. 64 (MTG CBSE Champion Chemistry Class 11)

23. The first inert gas which contains  $d$ -electrons is krypton. Its atomic number is 36 and its electronic configuration is :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$ .

Total number of  $d$ -electrons = 10

Total number of  $p$ -electrons =  $6 + 6 + 6 = 18$

Total number of  $s$ -electrons =  $2 + 2 + 2 + 2 = 8$

$\therefore$  Difference in total number of  $p$ - and  $s$ -electrons =  $18 - 8 = 10$ .

Thus, the inert gas is krypton.

OR

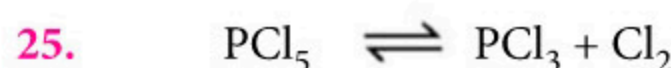
A and B belong to same group of periodic table because they have same number of valence electrons and belongs to  $p$ -block. A to D also belongs to  $p$ -block and E belongs to  $s$ -block.

24. Taking the initial volume as negligible (as no gaseous reactant is present), change in volume during expansion ( $\Delta V$ ) = 22.4 L. External pressure ( $P_{\text{ext}}$ ) = 1 atm

$$\Delta H = \Delta U + P\Delta V \text{ or } \Delta U = \Delta H - P\Delta V$$

$$P\Delta V = 1 \text{ atm} \times 22.4 \text{ L} = 22.4 \text{ L atm} = 22.4 \times 101.3 \text{ J} = 2269.12 \text{ J} = 2.3 \text{ kJ}$$

$$\therefore \Delta U = -154.4 - 2.3 = -156.7 \text{ kJ}$$



Initial 0.1 mol 0 0

At eqm.  $0.1 - x$   $x$   $x$

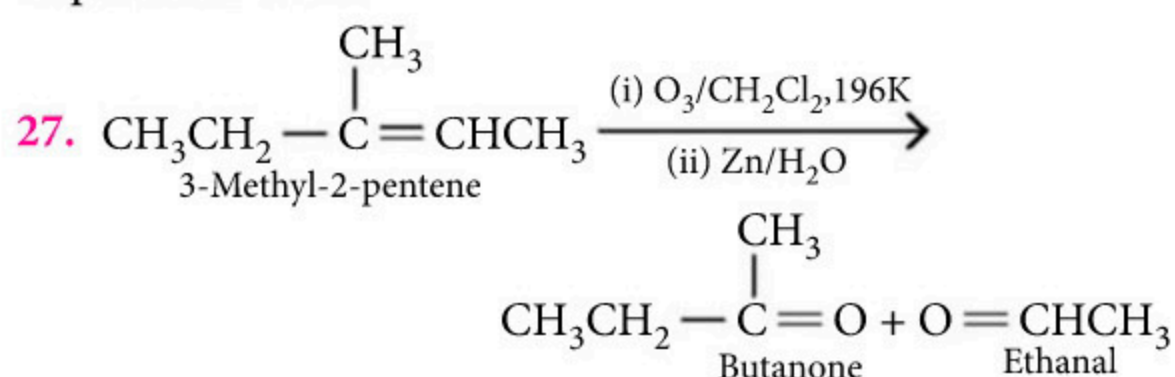
Total no. of moles at eqm. =  $0.1 + x$

$$PV = nRT \text{ or } n = \frac{PV}{RT} = \frac{1 \times 8}{0.0821 \times 540} = 0.18$$

$$\therefore 0.1 + x = 0.18 \Rightarrow x = 0.08 \therefore K_c = \frac{(0.08/8)(0.08/8)}{(0.02/8)} = 0.04$$

$$K_p = K_c(RT)^{\Delta n} = 0.04(0.0821 \times 540)^1 = 1.77$$

26. Temporary hardness of water is due to the presence of magnesium and calcium hydrogen carbonates. Permanent hardness of water is due to the presence of soluble salts of magnesium and calcium in the form of chlorides and sulphates in water.

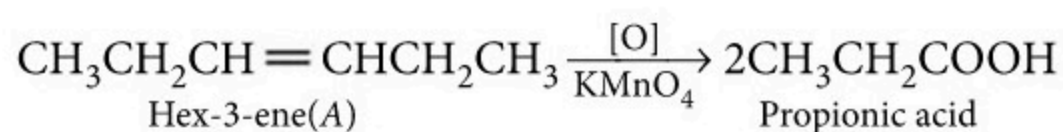


OR

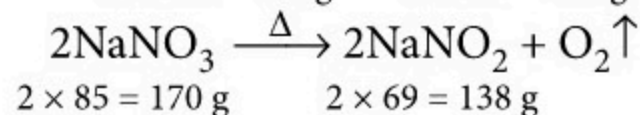
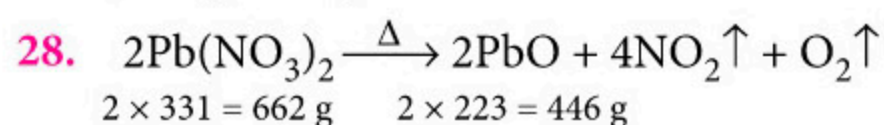
(i) Since, the hydrocarbon A adds one mole of  $\text{H}_2$  in presence of Pt to form  $n$ -hexane, therefore, A must be an hexene.

(ii) Since A on vigorous oxidation with  $\text{KMnO}_4$  gives a single carboxylic acid containing three carbon atoms, therefore, A must be a symmetrical hexene, i.e., hex-3-ene.





Thus, the given hydrocarbon A is hex-3-ene.



Suppose  $\text{Pb}(\text{NO}_3)_2$  in the mixture =  $x \text{ g}$

Then  $\text{NaNO}_3$  in the mixture =  $(5 - x) \text{ g}$

662 g of  $\text{Pb}(\text{NO}_3)_2$  give residue = 446 g

$$\therefore x \text{ g of } \text{Pb}(\text{NO}_3)_2 \text{ will give residue} = \frac{446}{662} \times x \text{ g} = 0.674 x \text{ g}$$

170 g of  $\text{NaNO}_3$  give residue = 138 g

$$\therefore (5 - x) \text{ g of } \text{NaNO}_3 \text{ will give residue} = \frac{138}{170} \times (5 - x) \text{ g} = 0.812 (5 - x) \text{ g}$$

Actual residue obtained = Mass taken - Mass lost

$$= 5 - \frac{28}{100} \times 5 \text{ g} = 3.6 \text{ g}$$

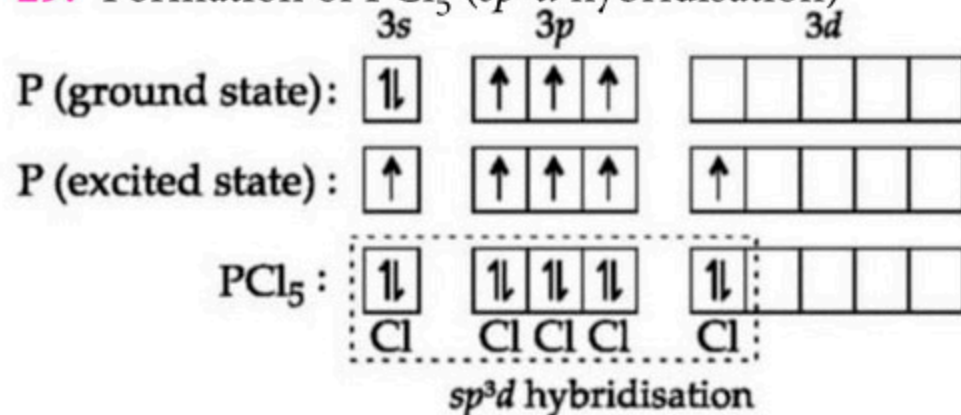
Thus, total residue =  $0.674x + 0.812(5 - x) = 3.6$

or  $0.138x = 0.46$  or  $x = 3.33 \text{ g}$

i.e.,  $\text{Pb}(\text{NO}_3)_2$  in the mixture = 3.33 g

$\text{NaNO}_3$  in the mixture =  $5 - 3.33 = 1.67 \text{ g}$

**29.** Formation of  $\text{PCl}_5$  ( $sp^3d$  hybridisation)

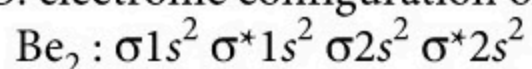


In  $\text{PCl}_5$ , there are three equatorial bonds and two axial bonds. The two axial bonds are at  $90^\circ$  to each other because the axial Cl atoms suffer more repulsion than the equatorial Cl atoms. As a result the axial Cl atoms try to reside far away from the equatorial Cl atoms and hence axial bonds are longer than equatorial bonds.

**OR**

**(a)** Beryllium atom has electronic configuration  $1s^2 2s^2$ . So, in  $\text{Be}_2$  there are total eight electrons which must be filled in four molecular orbitals.

M.O. electronic configuration of



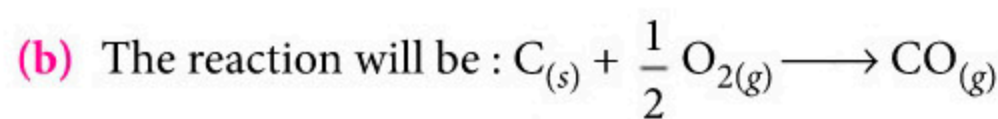
B.O. =  $1/2(4 - 4) = 0$ . Since the bond order is zero it shows that molecular beryllium will not exist.

**(b)** Refer to answer 182 Page no. 133 (MTG CBSE Champion Chemistry Class 11)

**30. (a)**  $V = 2.0 \text{ L}$ ,  $T = 298 \text{ K}$ ,  $n = 1.25 \text{ mol}$  (because only gas will exert pressure). Hence,

$$PV = nRT$$

$$\text{or } P = \frac{nRT}{V} = \frac{(1.25 \text{ mol})(0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1})(298 \text{ K})}{2.0 \text{ L}} = 15.3 \text{ atm}$$



As 1 mol of C reacts with  $\frac{1}{2}$  mol of  $\text{O}_2$ , the limiting reactant will be 1.25 mol of  $\text{O}_2$ . Thus,  $\frac{1}{2}$  mol of  $\text{O}_2$  produces  $\text{CO} = 1 \text{ mol}$ .

$\therefore$  1.25 mol of  $\text{O}_2$  will produce  $\text{CO} = 2.50 \text{ mol}$ .

Now,  $n(\text{gaseous}) = 2.50 \text{ mol}$ . Hence,

$$P = \frac{nRT}{V} = \frac{(2.50 \text{ mol})(0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1})(298 \text{ K})}{2.0 \text{ L}} = 30.6 \text{ atm}$$

**31. (a)** (i) Oxidation number of Mn in  $\text{KMnO}_4$ :

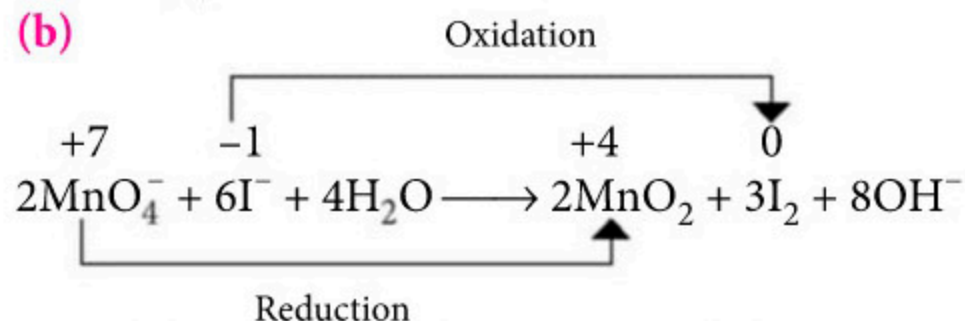
$$1 + x + (-2) \times 4 = 0 \Rightarrow x = +7$$

(ii)  $\text{CaO}_2$

Let oxidation number of O be  $x$ ,

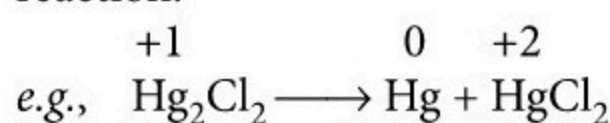
$$+2 + 2(x) = 0 \Rightarrow 2x = -2 \therefore x = -1$$

**(b)**



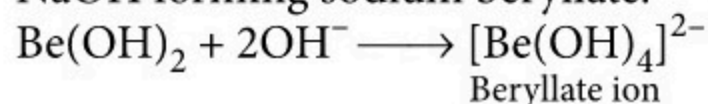
Here,  $\text{MnO}_4^-$  is an oxidising agent as it itself gets reduced and  $\text{I}^-$  is a reducing agent as it itself gets oxidised.

**(c)** A reaction in which a particular species simultaneously gets oxidised and reduced, is known as disproportionation reaction.



In this reaction,  $\text{Hg}_2\text{Cl}_2$  is getting oxidised to  $\text{HgCl}_2$  and also getting reduced to  $\text{Hg}$ .

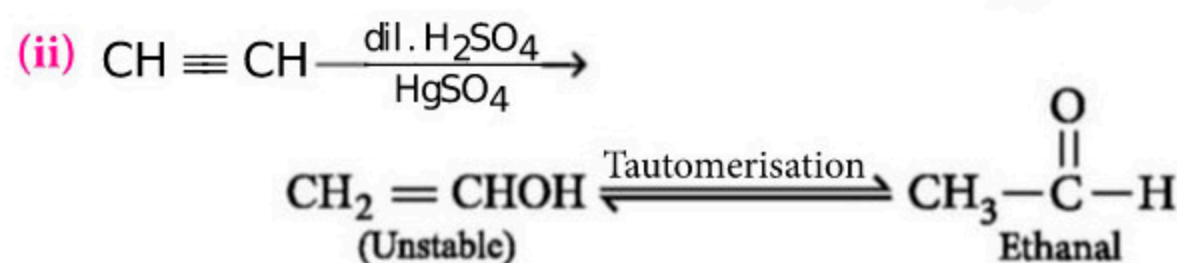
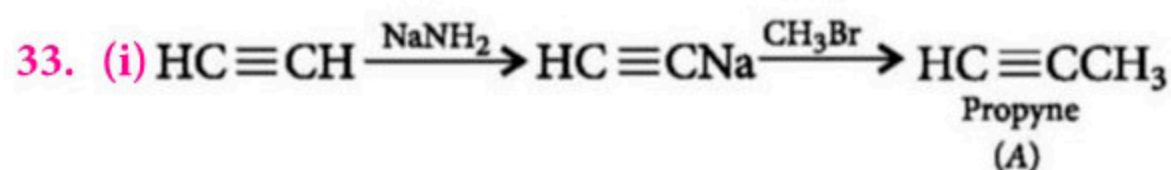
**32. (i)**  $\text{Be}(\text{OH})_2$  is amphoteric and hence it dissolves in  $\text{NaOH}$  forming sodium beryllate.



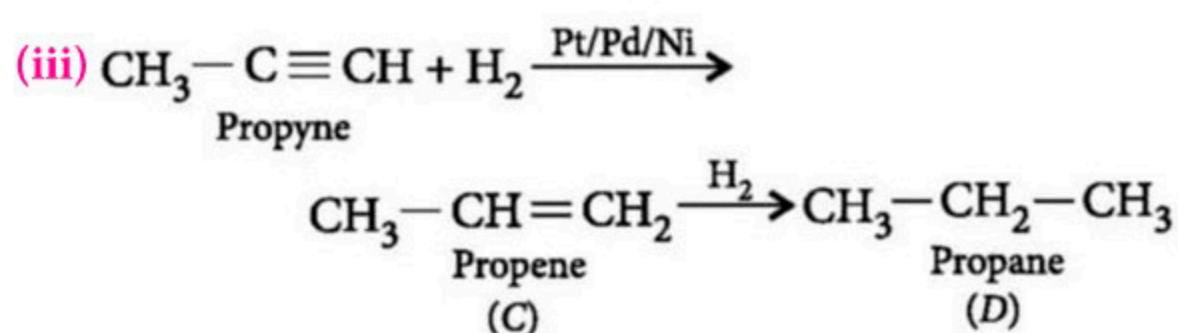
$\text{Mg}(\text{OH})_2$  on the other hand, being basic does not dissolve in  $\text{NaOH}$ .

**(ii)**  $\text{MgO}$  has high lattice energy due to greater charge and smaller ionic size of  $\text{Mg}^{2+}$  and  $\text{O}^{2-}$  ions. As a result, it has a very high melting point and hence is used as a refractory material.

**(iii)** Pure sodium chloride melts at 1084 K. The cost of electricity to attain and maintain this temperature is very high. Furthermore,  $\text{Cl}_2$  gas evolved during electrolysis has corrosive action on the cell at high temperatures. Therefore, to lower the fusion temperature to 850-875 K, some  $\text{CaCl}_2$  and  $\text{KF}$  are added to molten  $\text{NaCl}$ .

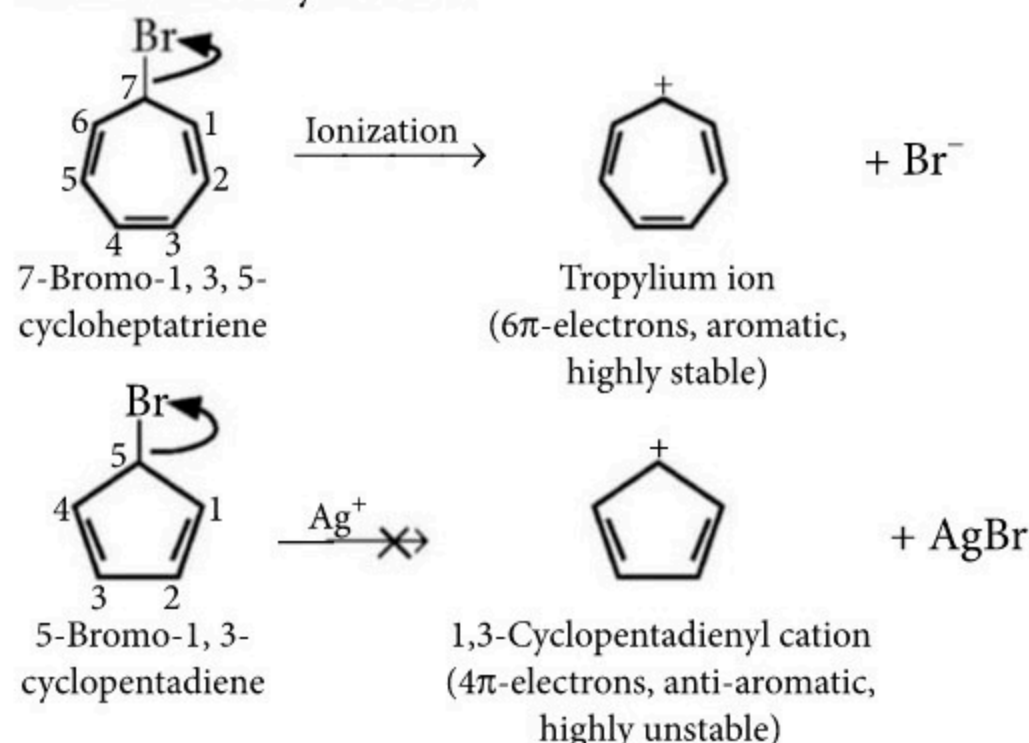






OR

7-Bromo-1, 3, 5-cycloheptatriene, on ionization, gives tropylium ion. Since, tropylium ion contains  $6\pi$ -electrons which are completely delocalized, therefore, according to Huckel rule, it is aromatic and hence stable. Being highly stable it is easily formed.



In contrast, 5-bromo-1, 3-cyclopentadiene, on ionization, will give 1, 3-cyclopentadienyl cation which contains  $4\pi$ -electrons and hence is anti-aromatic. Being anti-aromatic, it is highly unstable and hence is not formed even in the presence of  $\text{Ag}^+$  ion which otherwise facilitates ionization.

34. (i) In dry cleaning liquefied  $\text{CO}_2$  along with a suitable detergent is used and for bleaching, hydrogen peroxide is used which gives better results and is not harmful.

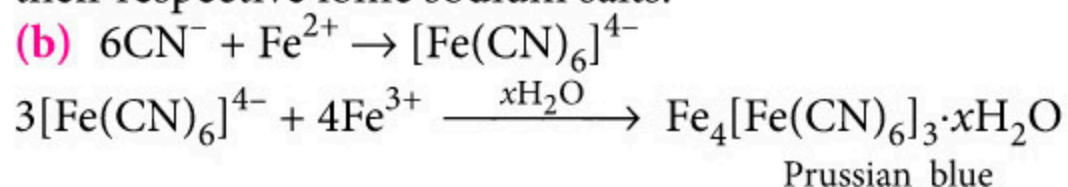
(ii) Soaps should be used in place of detergents because soaps are 100% biodegradable and do not cause any pollution problem. Now a days, soft detergents are available which are biodegradable. They can be used in place of 'hard detergents' which are non-biodegradable.

(iii) (a) CNG may be used as it causes much less pollution.  
 (b) Electrical vehicles should be used which have zero pollution. We expect a large number of electrical cars and two wheelers on the road in near future.

35. Refer to answer 173 Page no. 364 (MTG CBSE Champion Chemistry Class 11)

OR

(a) The organic compound is fused with sodium so as to convert N, S and halogen present in the organic compound to their respective ionic sodium salts.

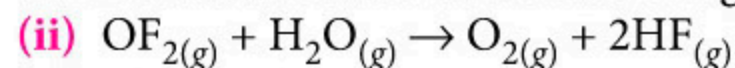


Iron(III) hexacyanoferrate(II)

(c) Refer to answer 232 Page no. 369 (MTG CBSE Champion Chemistry Class 11)

36. (i) (a) Given enthalpy change is not enthalpy of formation of  $\text{CaCO}_3$  because it is not being formed from constituting elements.

(b) Given enthalpy change is not enthalpy of formation of HBr because 2 moles of HBr are being formed.



$$\Delta n = 1 + 2 - 2 = 1$$

$$\begin{aligned} \Delta_r H^\circ &= \sum \Delta_f H^\circ_{(\text{products})} - \sum \Delta_f H^\circ_{(\text{reactants})} \\ &= \Delta_f H^\circ(\text{O}_2) + 2\Delta_f H^\circ(\text{HF}) - \Delta_f H^\circ(\text{OF}_2) - \Delta_f H^\circ(\text{H}_2\text{O}) \\ &= 0 + 2 \times (-268.6) - 23.0 - (-241.8) \\ &= -537.2 - 23.0 + 241.8 = -318.4 \text{ kJ/mol} \end{aligned}$$

$$\Delta_f H^\circ = \Delta_r U^\circ + \Delta n_g RT$$

$$-318.4 \text{ kJ} = \Delta_r U^\circ + \frac{1 \times 8.314 \times 300}{1000} \text{ kJ}$$

$$-318.4 \text{ kJ} = \Delta_r U^\circ + 2.4942 \text{ kJ}$$

$$\therefore \Delta_r U^\circ = -320.9 \text{ kJ}$$

OR

(i) Irreversible expansion takes place when external pressure ( $P_{\text{ext}}$ ) remains constant.

$$w_{\text{irrev}} = -P_{\text{ext}}(V_2 - V_1) = -P_{\text{ext}} \Delta V$$

(ii) Reversible expansion takes place when internal pressure is infinitesimally greater than external pressure at every stage. Thus, external pressure has to be adjusted throughout.

$$w_{\text{rev}} = -nRT \ln V_2/V_1$$

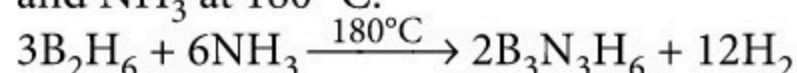
(iii) The expansion is irreversible. Further, as  $P_{\text{ext}} = 0$ , therefore,  $w = -P_{\text{ext}} \Delta V = 0 \times (\Delta V) = 0$

(iv) When gas is compressed, work is done on the gas. For isothermal reversible compression,

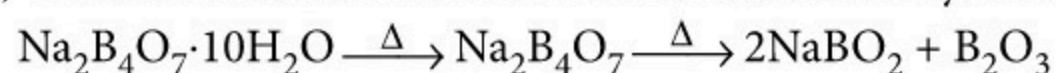
$$w = +nRT \ln P_2/P_1$$

(v) For adiabatic expansion, temperature falls, i.e.,  $T_2 < T_1$   
 $w = C_v(T_2 - T_1)$ , i.e.,  $w$  is -ve.

37. (a) Molecular formula of inorganic benzene is  $\text{B}_3\text{N}_3\text{H}_6$ . It is a volatile compound and is called inorganic benzene because of the similarity of its structure with benzene. It has a six membered ring of alternating B and N atoms, each is further linked to a H atom. It is prepared by reacting  $\text{B}_2\text{H}_6$  and  $\text{NH}_3$  at  $180^\circ\text{C}$ .



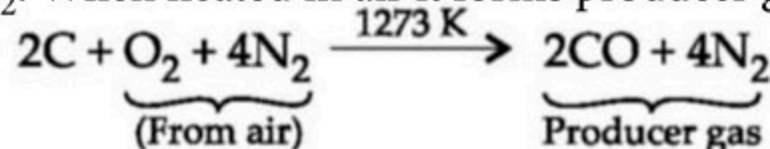
(b) (i) When powdered borax is heated strongly on the Bunsen burner, it forms colourless transparent glassy (glass like) bead made of sodium metaborate and boric anhydride.



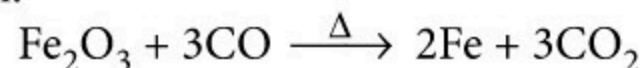
(ii) Refer to answer 69(b) Page no. 323 (MTG CBSE Champion Chemistry Class 11)

OR

(a) The tetravalent element is carbon which forms CO and  $\text{CO}_2$ . When heated in air it forms producer gas.



CO is a powerful reducing agent and reduces ferric oxide to iron.

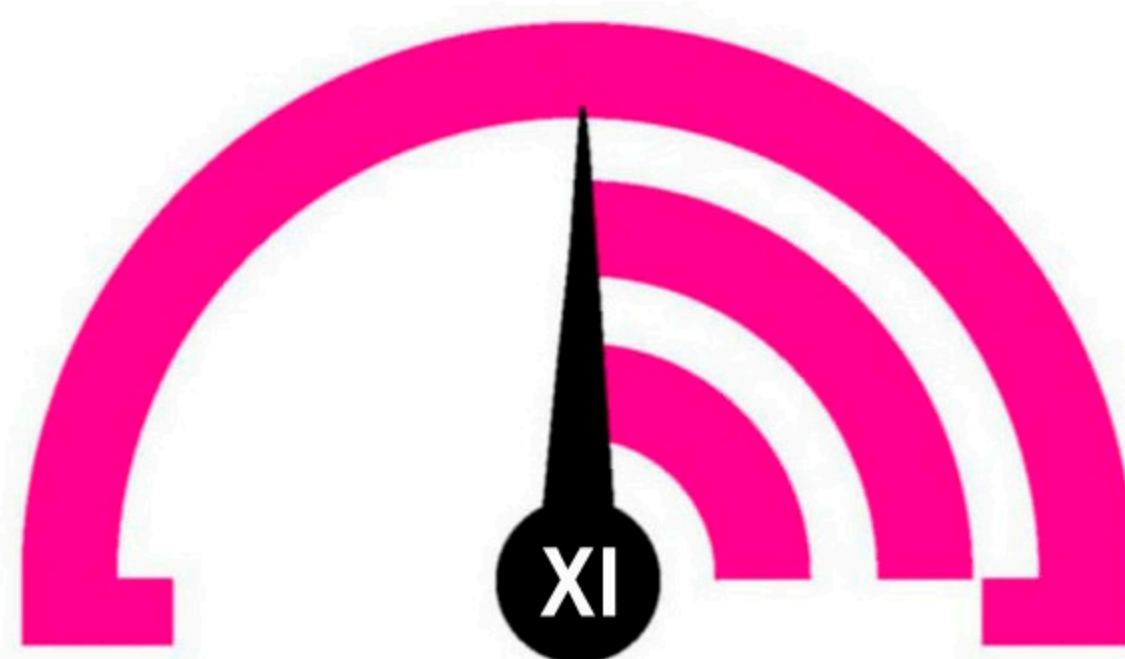


(b) Refer to answer 160 Page no. 328 (MTG CBSE Champion Chemistry Class 11)





# MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

## States of Matter | Thermodynamics

Time Taken : 60 Min.

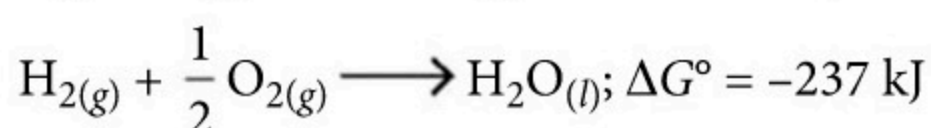
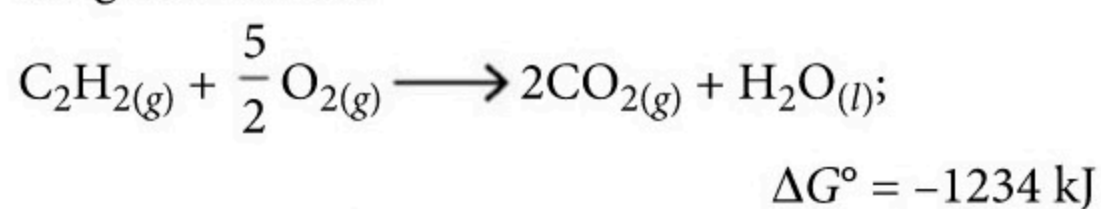
### NEET

#### Only One Option Correct Type

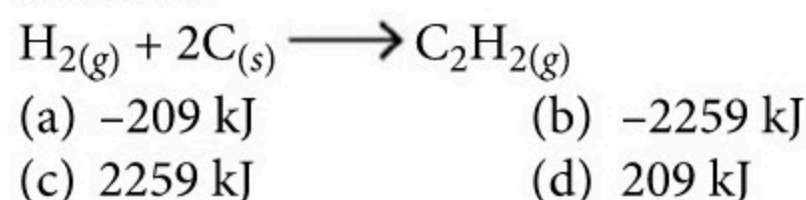
1. For non-zero value of force of attraction between gas molecules, gas equation will be

(a)  $PV = nRT - \frac{n^2}{V}a$  (b)  $PV = nRT + nbP$   
 (c)  $P = \frac{nRT}{V - b}$  (d)  $PV = nRT$

2. The free energy change for the following reactions are given below :



What is the standard free energy change for the reaction?



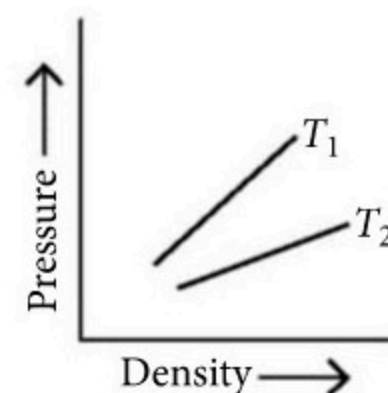
3. Containers A and B have same gases. Pressure, volume and temperature of A are all twice that of B, then the ratio of number of molecules of A and B are  
 (a) 1 : 2 (b) 2 : 1  
 (c) 1 : 4 (d) 4 : 1

4. In which of the following conditions a chemical reaction cannot occur?  
 (a)  $\Delta H$  and  $\Delta S$  increases and  $T\Delta S > \Delta H$   
 (b)  $\Delta H$  and  $\Delta S$  decreases and  $\Delta H > T\Delta S$   
 (c)  $\Delta H$  increases and  $\Delta S$  decreases  
 (d)  $\Delta H$  decreases and  $\Delta S$  increases

5. Surface tension of water is  $73 \text{ dyne cm}^{-1}$  at  $20^\circ\text{C}$ . If surface area is increased by  $0.10 \text{ m}^2$ , work done is  
 (a) 7.3 erg (b)  $7.3 \times 10^4 \text{ erg}$   
 (c) 73 J (d) 0.73 J

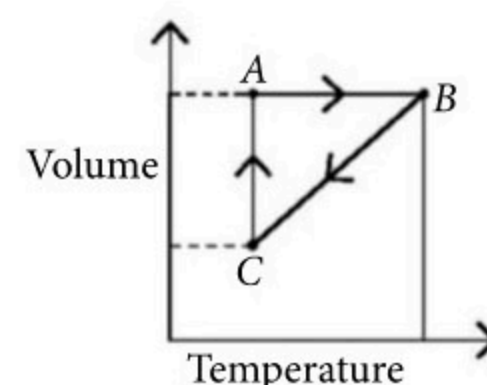
6. 4.48 L of an ideal gas at STP requires 12.0 calories to raise its temperature by  $15^\circ\text{C}$  at constant volume. The  $C_p$  of the gas is  
 (a) 3 cal (b) 4 cal (c) 7 cal (d) 6 cal

7. Figure shows graphs of pressure vs. density for an ideal gas at two temperatures  $T_1$  and  $T_2$ . Which of the following options is correct?



- (a)  $T_1 > T_2$   
 (b)  $T_1 = T_2$   
 (c)  $T_1 < T_2$  (d) None of these
8. Heat of dissociation of benzene to elements is  $5535 \text{ kJ mol}^{-1}$ . The bond enthalpies of C—C, C=C and C—H are 347.3, 615.0 and 416.2 kJ respectively. Resonance energy of benzene is  
 (a) 1.51 kJ (b) 15.1 kJ (c) 151 kJ (d) 1511 kJ.
9. If for two gases of molecular weights  $M_A$  and  $M_B$  at temperature  $T_A$  and  $T_B$ ,  $T_A M_B = T_B M_A$ , then which property has the same magnitude for both the gases?  
 (a) Density (b) Pressure  
 (c) KE per mole (d)  $u_{\text{rms}}$

10. Five moles of a gas is put through a series of changes as shown graphically in a cyclic process. The processes  $A \rightarrow B$ ,  $B \rightarrow C$  and  $C \rightarrow A$  are respectively





- (a) isochoric, isobaric and isothermal
- (b) isobaric, isochoric and isothermal
- (c) isochoric, isothermal and isobaric
- (d) isobaric, isothermal and isochoric.

11. Pure hydrogen sulphide is stored in a tank of 100 litre capacity at 20°C and 2 atm pressure. The mass of the gas will be  
 (a) 34 g (b) 340 g  
 (c) 282.68 g (d) 28.24 g
12. Consider the reaction  $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$  carried out at constant temperature and pressure. If  $\Delta H$  and  $\Delta U$  are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?  
 (a)  $\Delta H = 0$  (b)  $\Delta H = \Delta U$   
 (c)  $\Delta H < \Delta U$  (d)  $\Delta H > \Delta U$

#### Assertion & Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- (c) If assertion is true but reason is false.
- (d) If both assertion and reason are false.

13. **Assertion :** Most probable velocity is the velocity possessed by maximum fraction of molecules at the same temperature.

**Reason :** On collision, more and more molecules acquire higher speed at the same temperature.

14. **Assertion :** The enthalpy of formation of gaseous oxygen molecules at 298 K and under a pressure of 1 atm is zero.

**Reason :** The entropy of formation of gaseous oxygen molecules under the same conditions is zero.

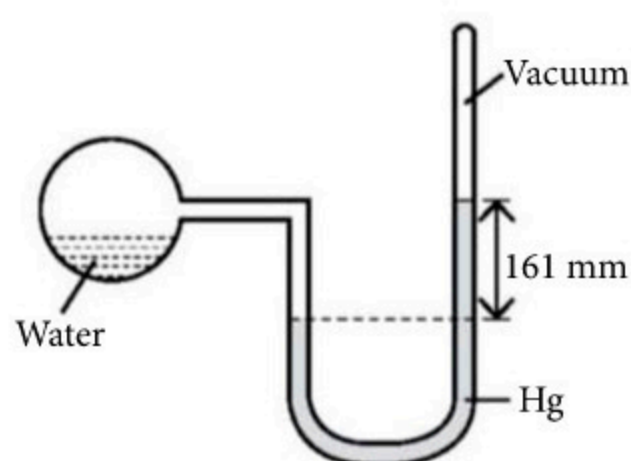
15. **Assertion :** The heat of neutralisation of perchloric acid,  $\text{HClO}_4$ , with  $\text{NaOH}$  is same as that of  $\text{HCl}$  with  $\text{NaOH}$ .

**Reason :** Both  $\text{HCl}$  and  $\text{HClO}_4$  are strong acids.

#### JEE MAIN / ADVANCED

##### Only One Option Correct Type

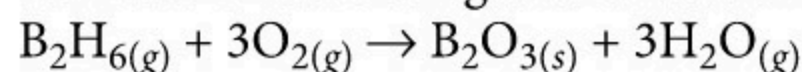
16. The given system is in equilibrium at 27°C and the volume of the bulb is 150 mL. At 27°C, aqueous tension of water is 28 mm of Hg. If the bulb contains



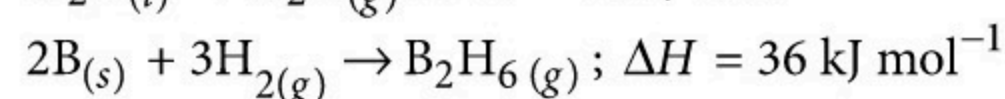
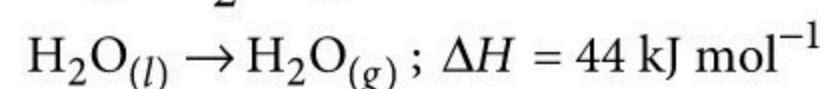
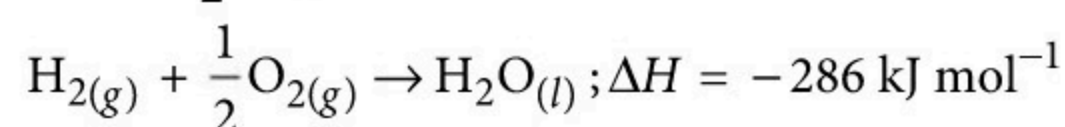
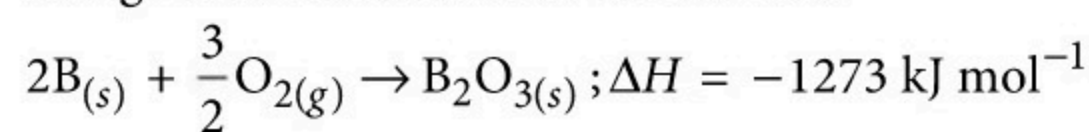
0.001 mol of  $\text{O}_2$ , volume of liquid water present in the bulb is nearly

- (a) 10 mL (b) 20 mL (c) 30 mL (d) 40 mL.

17. Diborane is a potential rocket fuel which undergoes combustion according to the reaction,



From the following data, calculate the enthalpy change for the combustion of diborane.



- (a)  $\Delta H = 2035 \text{ kJ}$  (b)  $\Delta H = -2035 \text{ kJ}$
- (c)  $\Delta H = 1023 \text{ kJ}$  (d)  $\Delta H = -7052 \text{ kJ}$

18. 4.215 g of a metallic carbonate was heated in a hard glass tube and the  $\text{CO}_2$  evolved was found to measure 1336 mL at 27°C and 700 mm pressure. What is the equivalent weight of the metal?

- (a) 15.20 (b) 20.15 (c) 19.45 (d) 12.16

19. In conversion of limestone to lime,  $\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$  the values of  $\Delta H^\circ$  and  $\Delta S^\circ$  are +179.1 kJ mol<sup>-1</sup> and 160.2 J/K respectively at 298 K and 1 bar. Assuming that  $\Delta H^\circ$  and  $\Delta S^\circ$  do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is

- (a) 1118 K (b) 1008 K
- (c) 1200 K (d) 845 K

#### More than One Options Correct Type

20. Which of the following are the equation of Boyle's law?

(a)  $\left(\frac{dp}{dV}\right)_T = \frac{K}{V}$  (b)  $\left(\frac{dp}{dV}\right)_T = -\frac{K}{V^2}$

(c)  $\left(\frac{dp}{dV}\right)_T = \frac{K^2}{V}$  (d)  $V \propto \frac{1}{p}$

21. In a closed insulated container a liquid is stirred with a paddle to increase the temperature which of the following are not true?

- (a)  $\Delta U = W \neq 0, q = 0$  (b)  $\Delta U = W = q \neq 0$
- (c)  $\Delta U = 0, W = q \neq 0$  (d)  $W = 0, \Delta U = q \neq 0$

22. Which of the following statements are correct?

- (a) The ratio of the mean speed to the *rms* speed is independent of the temperature.
- (b) The square of the mean speed of the molecules is equal to the square of the *rms* speed at a certain temperature.



- (c) Mean kinetic energy of the gas molecules at any given temperature is independent of the mean speed.
- (d) The difference between the *rms* speed and the mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered.

23. The correct expressions for an adiabatic process are

(a)  $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$  (b)  $\frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{\gamma-1}$

(c)  $P_1 V_1^\gamma = P_2 V_2^\gamma$  (d)  $P_1 V_1^{\gamma-1} = P_2 V_2^{\gamma-1}$

### Numerical Value Type

24. 3.7 g of a gas at 25°C occupied the same volume as 0.184 g of hydrogen at 17°C and at the same pressure. What is the molecular weight of the gas?
25. The enthalpy change involved in the oxidation of glucose is  $-2880 \text{ kJ mol}^{-1}$ . Twenty five per cent of this energy is available for muscular work. If 100 kJ of muscular work is needed to walk one kilometer, what is the maximum distance in km that a person will be able to walk after eating 120 g of glucose?
26. Calculate the volume occupied in L by 5.0 g of acetylene gas at 50°C and 740 mm pressure.

### Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

The deviation from ideal gas behaviour can also be expressed by compressibility factor *Z*. Compressibility factor is the ratio of volume of real gas,  $V_{\text{real}}$  to the ideal volume of the gas,  $V_{\text{ideal}}$ .

$$Z = \frac{PV_{\text{real}}}{nRT} = \frac{V_{\text{real}}}{V_{\text{ideal}}}, \quad V_{\text{ideal}} = \frac{nRT}{P}$$

|    | Column-I                              |     | Column-II                        |
|----|---------------------------------------|-----|----------------------------------|
| P. | <i>Z</i> for ideal gas                | I.  | 3/8                              |
| Q. | <i>Z</i> for real gas at low <i>P</i> | II. | $\left(1 + \frac{Pb}{RT}\right)$ |

|    |  |      |                                  |
|----|--|------|----------------------------------|
| R. | <i>Z</i> for real gas at high <i>P</i> | III. | 1                                |
| S. | <i>Z</i> for critical state            | IV.  | $\left(1 - \frac{a}{RTV}\right)$ |

27. Which of the following has the correct combination considering column-I and column-II?
- (a)  $P \rightarrow \text{II}$  (b)  $Q \rightarrow \text{III}$
- (c)  $R \rightarrow \text{IV}$  (d)  $S \rightarrow \text{I}$
28. Which of the following has the correct combination considering column-I and column-II?
- (a)  $P \rightarrow \text{III}$  (b)  $Q \rightarrow \text{I}$
- (c)  $R \rightarrow \text{IV}$  (d)  $S \rightarrow \text{II}$

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

Free energy,  $G = H - TS$ , is a state function that indicates whether a reaction is spontaneous or non-spontaneous.

$$\Delta G = \Delta H - T\Delta S$$

If  $\Delta G < 0$ , the reaction is spontaneous.

If  $\Delta G > 0$ , the reaction is non-spontaneous.

If  $\Delta G = 0$ , the reaction is at equilibrium.

|    | Column-I<br>(Parameters)<br>Sign of $\Delta H$ Sign of $\Delta S$ |   | Column-II<br>(Description for spontaneity) |                                  |
|----|---|---|--|----------------------------------|
| P. | -   | + | I.   | Non-spontaneous at any <i>T</i>  |
| Q. | +   | - | II.  | Spontaneous at any <i>T</i>      |
| R. | -   | - | III.                                       | Non-spontaneous at low <i>T</i>  |
| S. | +   | + | IV.  | Non-spontaneous at high <i>T</i> |

29. Which of the following has the correct combination considering column-I and column-II?
- (a)  $P \rightarrow \text{IV}$  (b)  $Q \rightarrow \text{I}$
- (c)  $R \rightarrow \text{III}$  (d)  $S \rightarrow \text{II}$
30. Which of the following has the correct combination considering column-I and column-II?
- (a)  $P \rightarrow \text{I}$  (b)  $Q \rightarrow \text{III}$
- (c)  $R \rightarrow \text{IV}$  (d)  $S \rightarrow \text{II}$

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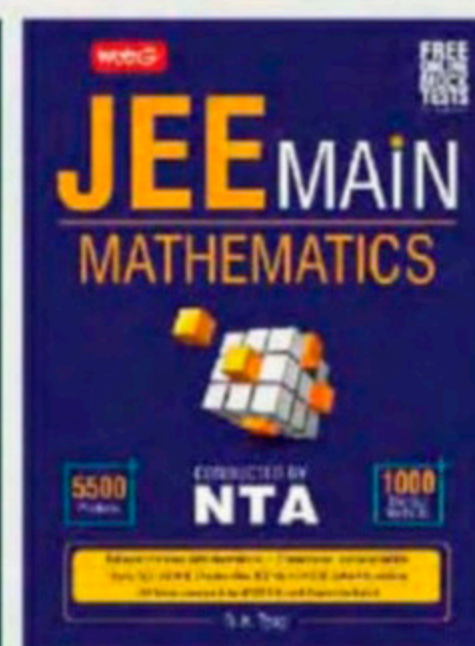
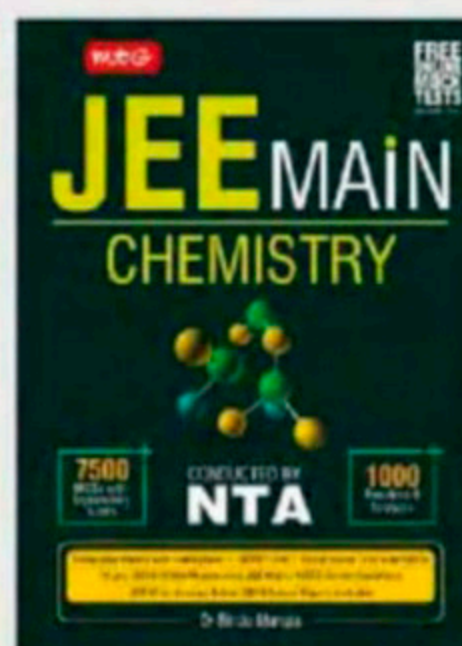
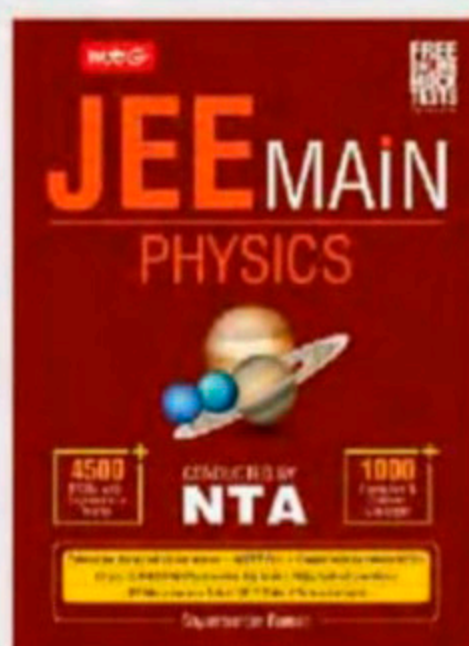


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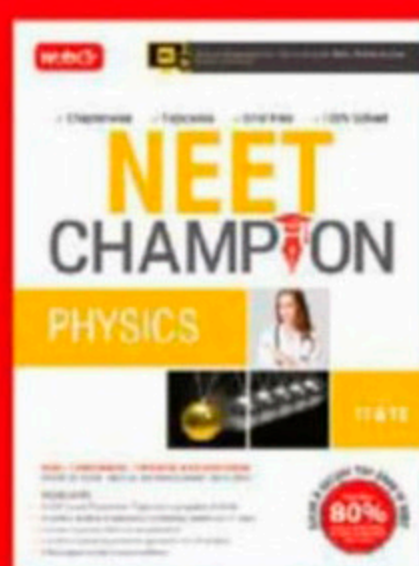


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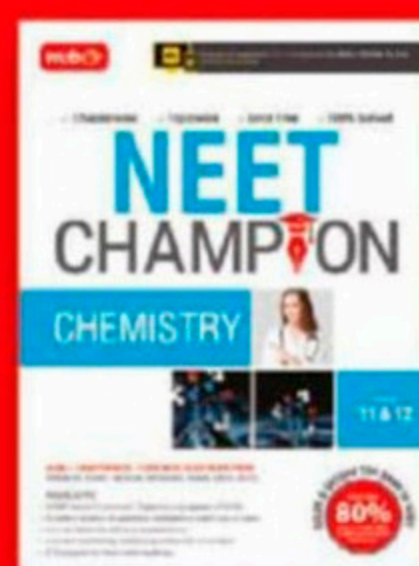
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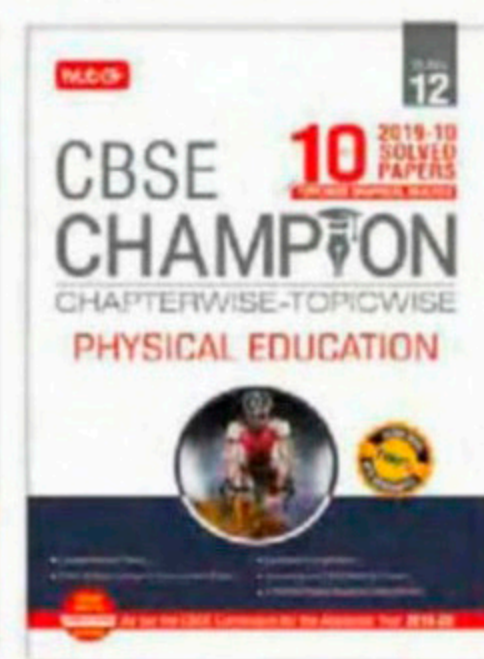
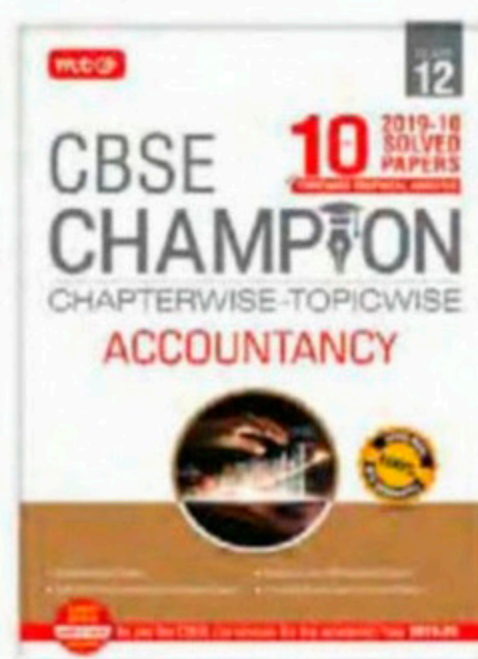
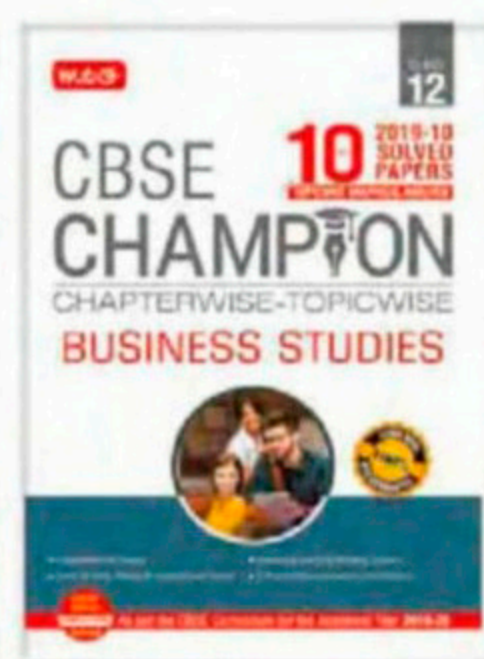
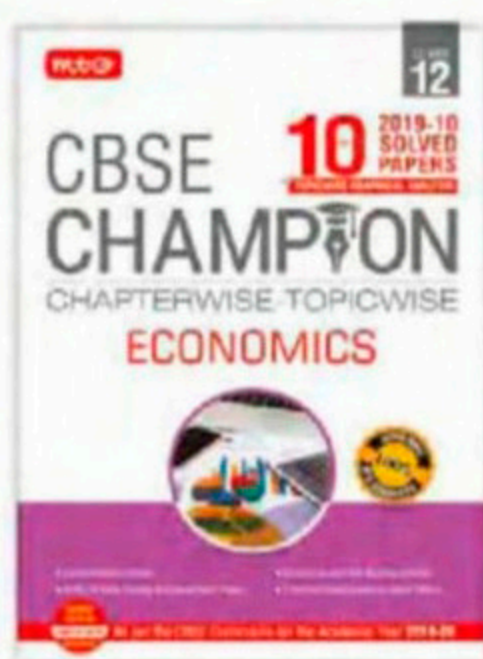
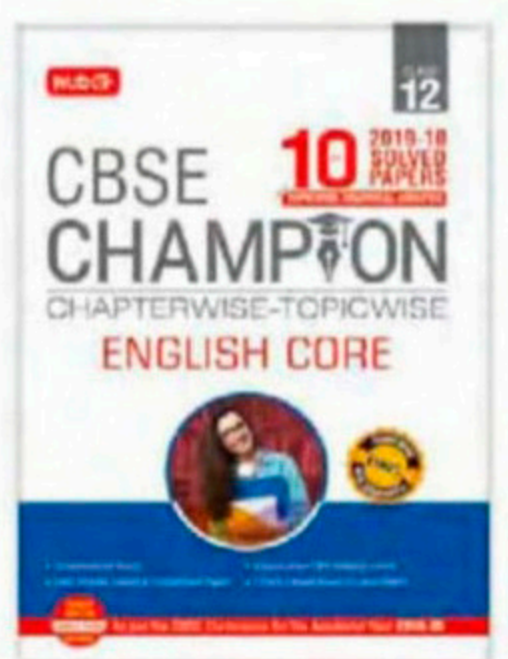
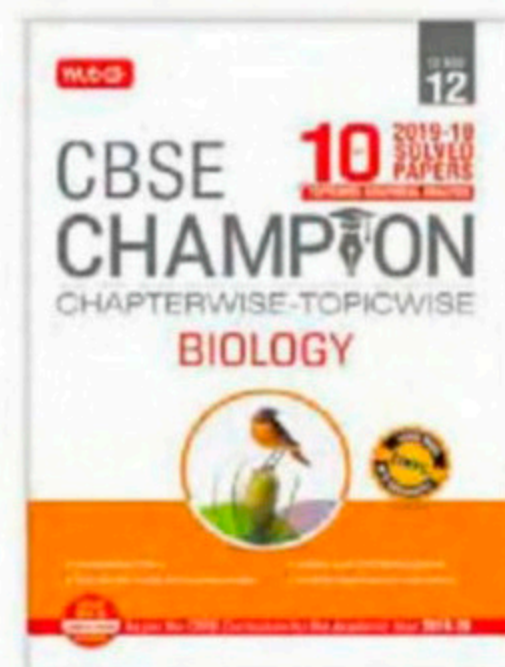
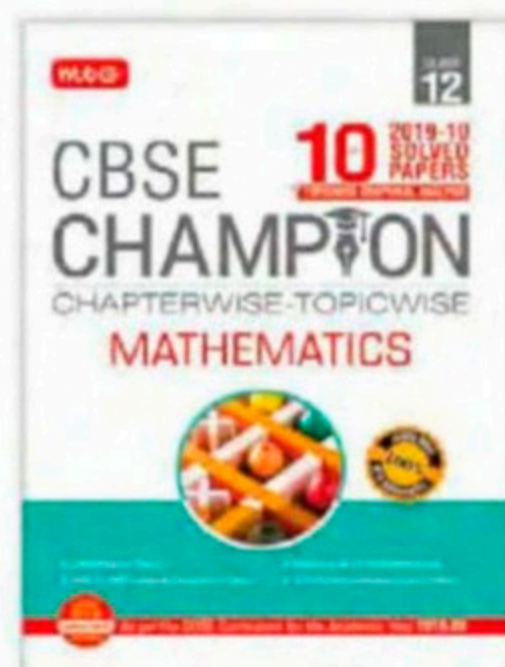
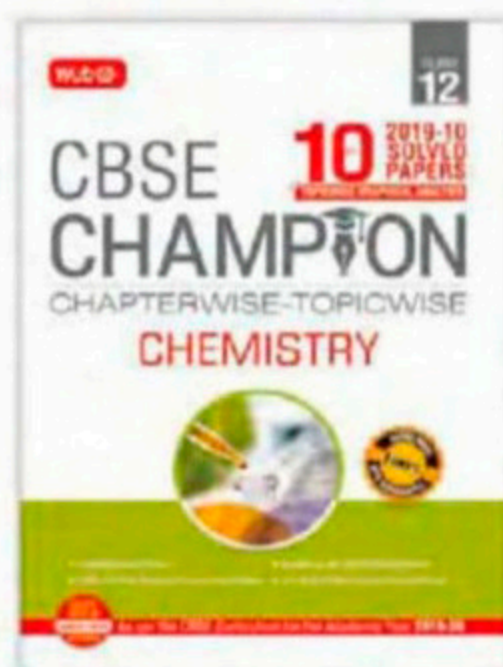
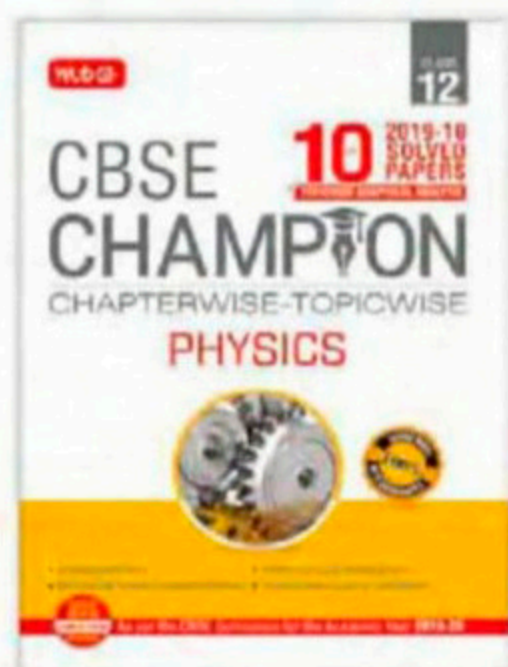


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